

FOURTEENTH EDITION

Health & Wellness

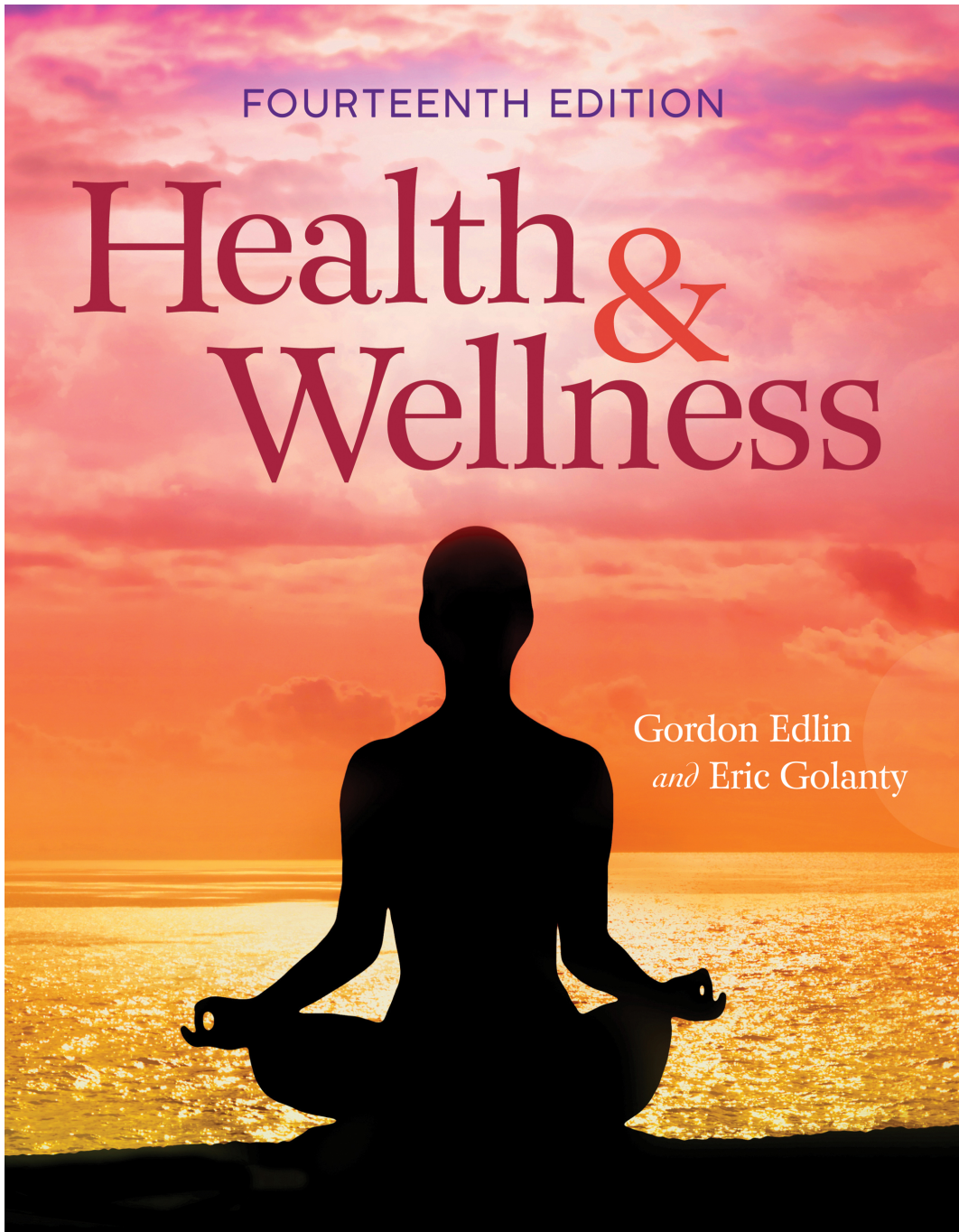
Gordon Edlin
and Eric Golanty



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Gordon Edlin, Ph.D.

Professor of Genetics Emeritus
University of California, Davis, California

Eric Golanty, Ph.D.

Professor of Health Emeritus
Las Positas College, Livermore, California



JONES & BARTLETT
LEARNING



World Headquarters

Jones & Bartlett Learning

25 Mall Road, Suite 600

Burlington, MA 01803

978-443-5000

info@jblearning.com

www.jblearning.com

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PREFACE

It is with particular pride that we present the fourteenth edition of *Health and Wellness*. Publication of this edition in 2022 represents more than 35 years of continuous use of this textbook by students and instructors in many colleges and universities since the first edition appeared in 1982. A lot has happened to us (the authors), to book publishing, and to the world since then. We are much older, books are available online in digital format, and the world has changed in ways too numerous to mention except one: the existential threat of climate change. However, the visions we (the authors) had of health and how to achieve it are as true today as they were 30 years ago. When we conceived of writing a college-level textbook, rather than focusing on hygiene and disease, as was the custom at the time, instead we chose to present the rationale and scientific evidence for prevention of disease and illness and for individual self-responsibility for fostering a state of well-being and maintaining one's health. Well-being and self-responsibility are now accepted as fundamental in health education. Personal behaviors, lifestyle, mental attitudes, and physical activities are what lead to overall health and wellness.

In recent decades, medical science has made truly remarkable advances in curing or alleviating serious health conditions. At the

same time, medical science includes not only better treatment of disease but also acknowledging the importance of patients taking change of their own health and well-being. As the pandemics of heart disease, obesity, diabetes, and infectious diseases represented by COVID-19, malaria, tuberculosis, and HIV, spread around the world, as pollution threatens the livability of the environment, and climate change threatens the health of the entire planet, everyone must understand how their behaviors and attitudes contribute to their personal health or illness and the living things that share Earth with them. The information and guidelines that we set out in previous editions of this book are no less applicable in today's world.

How to Use this Text

We have developed several features to help you learn about health and wellness in this book.

Each chapter of the book begins with a list of **Learning Objectives** to help you focus on the most important concepts in that chapter.

LEARNING OBJECTIVES

1. Describe the medical and wellness models of health.
2. List the key points of the World Health Organization's definition of health.
3. List and describe the six dimensions of wellness.
4. List the three health behaviors responsible for most of the actual causes of death.
5. Define *lifestyle disease*.
6. Identify the goals of *Healthy People 2030*.
7. List and describe the major health issues of college students.
8. Describe the Health Belief Model, Transtheoretical Model, and Theory of Reasoned Action.

most people think that health is what you have when you are not sick or dying. It's true that not feeling sick is an important aspect of health. Just as important, however, is having a sense of optimal **well-being**—a state of physical, mental, emotional, social, and spiritual wellness. In this view, health is not only being free of disease and disability but also living in harmony with yourself and with your social and physical environments (Sartorius, 2006). You foster your own health and well-being when you:

1. undertake healthy behaviors and practices such as consuming nutritious foods, engaging in daily body movement, attending to your mental and social well-being, and supporting actions that contribute to the health and well-being of your community, and the planet; and
2. refrain from health-harming behaviors (e.g., consuming unhealthy foods, smoking cigarettes, abusing drugs, or becoming overweight) and limit your exposure to health risks (e.g., driving after drinking).

Key Terms are defined at the end of each chapter as well as in the glossary at the end of the book.

Key Terms

fertilization: the fusion of a male's sperm cell with a female's ovum to form a fertilized egg
fallopian tubes: a pair of female, pelvic anatomical structures in which fertilization takes place
ovaries: a pair of almond-shaped structures in the female pelvic cavity that produce ova (eggs) and sex hormones
cervix: the opening in the lower part of the uterus that permits sperm to pass from the vagina to the uterus and a fetus to the outside at birth
menstruation: sloughing of the lining of the uterus and associated small blood vessels
menstrual cycle: near monthly production of fertilizable ova
vulvovaginitis: vaginal irritation, often called a yeast infection
failure rate: likelihood of becoming pregnant if using a birth control method for 1 year
lowest user failure rate: how well a method performs when used both as intended and consistently
typical user failure rate: estimates how well a method performs when all of the errors and problems typically encountered with a method are taken into account
fertility awareness methods: methods of birth control in which a couple charts the cyclic signs of

surgical sterilization: rendering a person virtually unable to have children but with no effect on the ability to engage in or enjoy sex
tubal ligation: a surgical procedure in women in which the fallopian tubes are cut, tied, or cauterized to prevent pregnancy; a form of sterilization
vasectomy: a surgical procedure in men in which segments of the vas deferens are removed and the ends tied to prevent the passage of sperm
emergency contraception: using contraceptive hormones or an IUD to interrupt a possible pregnancy
abortion: the expulsion or extraction of the products of conception from the uterus before the embryo or fetus is capable of independent life; abortions may be spontaneous or induced
medication abortion: nonsurgical abortion using specific medications to stop pregnancy
sexually transmitted disease (STD): an infection or infestation caused by a biological agent (e.g., virus, bacterium, insect) that is transferred from person to person by sexual interaction
human immunodeficiency virus (HIV): the cause of AIDS
trichomoniasis: vaginal infection caused by the protozoan *Trichomonas vaginalis*

Epigrams enliven each chapter with thought-provoking (and often humorous) quotations about health.

"The health of a people is really the foundation upon which all their happiness and all their powers as a state depend."
—Benjamin Disraeli, former Prime Minister of England

needs and is free of interpersonal violence and the threat of climate change.
Financial wellness: attaining and maintaining resources to meet physical, psychological, and social needs, including planning for the future and preparing for unforeseen

Health Tips in every chapter enable students to make immediate changes to their behavior.



The Two-Minute Stress Reducer

Stressed out?
Be still.
And take a
D
E
E
P
Breath.

Center Yourself

Focus your attention inward. Allow thoughts, ideas, and sensations to pass through your mind without reacting to any of them. You will notice them pass out of your mind, only to be replaced by new thoughts and sensations. Continue to breathe deeply and slowly and watch the passing of the thoughts that stress you.

Empty Your Mind

Acknowledge that you have preconceived ideas and ingrained habits of perceiving. Know that you can empty your mind of distressing thoughts and replace them with ones that create inner harmony.

Ground Yourself

Feel the sensation of your body touching the Earth. Place your feet (or your bottom if you are sitting, or your entire body if you are lying down) firmly on the Earth. Let your awareness come to your point of contact with the Earth, and feel gravity connecting you to Mother Earth and stabilizing you.

Connect

Allow yourself to feel your physical and spiritual connection with all living things. Renew yourself with every breath you are reestablishing your connection with all of nature.

Current topics are highlighted in boxes to give a complete perspective in your study of health and wellness. **Global Wellness** boxes explore health and wellness topics as they affect different countries and cultures.



Type 2 Diabetes as a Lifestyle Disease

Diabetes is a disease in which the amount of sugar in the blood increases to unhealthy levels as a result of malfunctions in the body's sugar-regulating system. There are two forms of diabetes:

1. **type 1 (insulin-dependent)** in which the pancreas (a digestive organ) is diseased and unable to manufacture the hormone insulin, which regulates the level of sugar in the blood; and
2. **type 2 (non-insulin-dependent)**, which is caused by too much fat in the blood (generally from being overweight) and results in the body becoming resistant to the actions of insulin (*insulin resistance*).

In 2021, approximately 8.5 % of the world's population—463 million individuals—were affected by type 2 diabetes. Type 2 diabetes is a major cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputation. About 10% of North American population has type 2 diabetes. Worldwide, type 2 diabetes is responsible for approximately 4 million deaths each year, making it the seventh leading cause of death in the world. The disease affects people of all ages and males and females equally. The global prevalence of type 2 diabetes is projected to increase to 700 million individuals by 2045.

The global epidemic of type 2 diabetes is considered to be the result of rapid worldwide economic development and urbanization in the last part of the 20th century. When people moved to cities for work, their living habits changed from consuming traditional diets that were somewhat balanced and moderate amounts of body movement to the consumption of unhealthy, processed, manufactured, and fast foods and a sedentary lifestyle. This is the reason type 2 diabetes is strongly associated with being overweight (Khan, Hashim, King, & Kahn, 2019). For every 20% increase in overweight, the chance of developing type 2 diabetes doubles. Type 2 diabetes is costly and often medically challenging to treat. Rather than drugs to control the medical consequences of type 2 diabetes, it is better for patients to eat healthfully and to engage in regular body movement (Nutrition Source, 2020). As shown in China, Finland, India, Japan, and the United States, community-based health programs are an effective way to help individuals prevent the onset of type 2 diabetes (Shirinzadeh, Atshin-Pour, Angeles, Gabor, & Agarwal, 2019). These programs offer individual and group-based educational sessions to help persons attain a healthy diet and incorporate movement and stress reduction activities into their lives.

World Diabetes Day is November 14 (<https://worlddiabetesday.org/>).

Wellness Guides offer tips, techniques, and steps toward a healthy lifestyle and self-responsibility.




Spirituality and Health

Many people find that spirituality—experiencing hope, comfort, and inner peace through religion, a connection with Nature, or a force larger than oneself—plays a role in health and illness. Spiritual experiences tend to engender feelings of compassion and empathy; peace of mind; relatedness and communion; and harmony with the environment. Spirituality can be a cornerstone of health because it represents a balance between the inner and outer aspects of human experience. For some, the spiritual dimension of life is embodied in the practice of a specific religion. For others, the spiritual dimension is nonreligious yet part of a personal philosophy. Many practices can help

people experience the spiritual realms of existence, including prayer, meditation, yoga, musical and artistic endeavors, and helping others.

Becoming more spiritually aware, regardless of the chosen path, can lead to a healthier life. Being in touch with your spiritual feelings helps you handle life's ups and downs with understanding and compassion for yourself and others. You become open to love in the highest sense of its meaning, which is acceptance and tolerance. You begin to love yourself despite your problems and hang-ups. You love your family and friends when relations are strained. You see beauty and harmony in more and more aspects of living. And occasionally—however fleetingly—you may experience the truly wondrous feeling of being completely and joyfully alive.

Managing Stress boxes give you practical strategies for coping with stress.



Mind-Body Harmony

When you are well and healthy, your body systems function harmoniously. If one of your organs is not functioning properly, however, the other organs may not be able to function correctly either, and you may become ill. Thus, disease may be regarded as the disruption of a whole person's physical and mental harmony.

In traditional Western science and medicine, mind-body harmony is considered in terms of homeostasis, the tendency for coordinated self-regulation among bodily processes that leads to optimal functioning and survival. Many Asian philosophies embody an idea of mind-body harmony. This idea is based on a universal energy called *chi* (or *qi*), which must be distributed harmoniously throughout the mind-body to attain and maintain health. Harmony is expressed as a balance of forces called yin and yang. Yin and yang represent the opposing and complementary aspects of the universal chi that is present in everything, including our bodies. Yang forces are characterized as light, positive, creative, full of movement, and having the nature of heaven. Yin forces are characterized as dark, negative, quiet, receptive, and having the nature of Earth.


The Yin-Yang Symbol
This symbol represents the harmonious balance of forces in Nature and in people. The white and dark dots show that there is always some yin in a person's yang component and

vice versa. The goal in life and Nature, according to the traditional Asian view, is to maintain a harmonious balance between yin and yang forces.


In Asian philosophies and medicine, body and mind are regarded as inseparable. Yin and yang apply to both mental and physical processes. When yin and yang forces are in balance in an individual, a state of harmony exists and the person experiences health and wellness. However, if either yin or yang forces come to predominate in a person, a state of disharmony is produced and disease may result.

Treatment of disease is designed to reestablish harmony of the mind and body. The balance of yin and yang forces must be restored so that health returns.

Tai chi ch'uan and *qigong* (pronounced jé-kung) are Chinese mind-body methods that are practiced by many North Americans to help maintain health and harmony. These exercises are especially useful for older persons whose bodies can no longer manage vigorous exercise. People who practice *qigong* experience lower blood pressure, improved circulation, and enhanced immune system functions.



Dollars & Health Sense boxes focus on the influence of economic forces on individual and community health; for example, the marketing of worthless and sometimes dangerous supplements and devices for weight management, fitness, and stress relief; direct-to-consumer advertising in the marketing of minimally effective and sometimes dangerous pharmaceuticals; and cigarette advertising to encourage youths to start smoking.



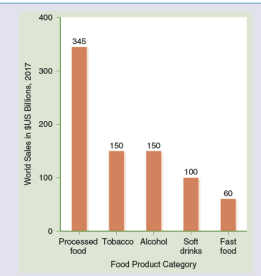
Profiting from Making People Sick

Heart disease, stroke, lung cancer, colon cancer, type 2 diabetes, and chronic obstructive pulmonary disease account for nearly half of all deaths in the United States. These diseases are caused in large part by unhealthy lifestyle choices: eating poorly, smoking cigarettes, being overweight, and not exercising. Unfortunately, many businesses profit from individuals' unhealthy lifestyles—indeed, some encourage unhealthy behavior as the basis of their business (Allen, 2019).

The tobacco industry is the prime example of profiting financially from harming others. No other industry makes a product that, when used as directed, causes disease and death. Knowing that long-term smokers (i.e., their best customers) tend to begin smoking as teens, the tobacco industry uses sophisticated marketing methods to lure young people to smoke and to get them hooked. The tobacco industry is a friend to no one.

Whereas it is not as obvious as with tobacco, some food companies also profit from harming their customers. A typical serving of fast food (e.g., burger, fries, and a soft drink or shake) contains around 1,000 calories, about half or more of most individuals' energy requirement for one day. This is why a steady diet of fast food can lead to weight problems and associated illnesses like type 2 diabetes.

Some of America's largest corporations are in the business of supplying consumers with less-than-healthy amounts of sugar (Figure 1.1A). The sugar is contained in packaged foods (from ketchup to breakfast cereals).




Food Product Category	World Sales in \$US Billions, 2017
Processed food	345
Tobacco	150
Alcohol	150
Soft drinks	100
Fast food	60

Figure 1.1A Sales Figures for 33 Leading Transnational Corporations in 2017 by Sector.

snack foods, fast foods, and sugar-sweetened beverages such as sodas, energy drinks, and sports drinks. Sugar-sweetened beverages alone deliver 36% of the added sugar that Americans consume, contributing to the risk of heart

Description

Chapters conclude with **Critical Thinking About Health**—a set of questions that present controversial or thought-provoking situations and ask you to examine your opinions and explore your biases.



Critical Thinking About Health

1. Identify one time in your life when you have been seriously ill (not counting colds or minor injuries). Describe the nature of the illness and the time it took to become well again. Discuss all of the factors that you think may have contributed to your becoming sick, including stress, emotional problems, poor nutrition, and so forth. Then discuss all of the factors that you believe contributed to your becoming well again, including medical care, prayer, family support, alternative medicines, and other factors. What were the most important factors that led to your becoming sick? What were the most important ones in the healing process?
2. In your opinion, what is the role of religion or spirituality in health? To what degree should religion or spirituality be part of a clinical encounter between a patient and a health practitioner?
3. Describe any experiences you have had with meditation, hypnosis, yoga, qigong, image visualization, or any other form of mental focusing and relaxation. Describe how you became involved with this activity and for what purpose you used it. Did it help you solve a particular health or emotional problem? Would you recommend this technique to others?

can cause bodily organs to malfunction, thus leading to illness. A dramatic example of the mind's power to affect health is the placebo effect. If a person believes in the power of a pill to cure or prevent disease, taking such a placebo pill will often work as well as a prescribed drug. Belief can heal because the mind has the power to change body chemistry.

Just as the body can be trained to do certain things, the mind also can be trained to calm anxieties and to facilitate healing. Techniques such as meditation, hypnosis, image visualization, and many others increase awareness of thoughts, reduce stress and emotional upset, and even alter body chemistry to promote healing and health. Learning and practicing meditation regularly or another of several mental relaxation techniques can provide lifelong tools for improving health and coping with upsetting situations that one encounters in life.

Highlights

- The human mind can cause changes in body chemistry through thoughts and feelings, which may have a positive or negative effect on your health.
- Optimal health is achieved when the mind and body communicate harmoniously.
- Disease can be regarded as disruption of homeostasis or disruption of the harmonious interaction of mind and body.
- The mind and organs of the body communicate

End-of-chapter material includes a **Chapter Summary** and **Highlights** (a brief review of the chapter), **References**, **Suggested Readings**, and **Recommended Websites** where you can find additional health information.

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Chapter Summary and Highlights

Chapter Summary

Our bodies and brains are intimately interconnected. The brain controls thousands of chemical reactions in the body moment by moment; conversely, the state of the body directly affects thoughts, feelings, and emotions. Optimal health depends on maintaining mind-body harmony so that both work together to keep you feeling well, energetic, strong, and aware of yourself and others. The brain automatically regulates essential functions of the body such as breathing, digestion, blood pressure and flow, and reaction to the environment such as stopping you from walking in front of a moving car or pulling your hand away from a flame. Most brain activities occur without conscious control. But the mind can be trained through various mental and physical techniques to be more effective in healing illnesses and injuries. On the other hand, if your mind is disturbed, anxious, or depressed, it

- The mind and organs of the body communicate continuously via the autonomic nervous system, which maintains vital body functions such as heart rate, level of blood sugar, and temperature.
- Psychosomatic illnesses are physical symptoms caused by stress, anxiety, and emotional upsets.
- Somatic symptom disorders are caused by psychosocial problems.
- The placebo effect often is almost as powerful as drugs in treating symptoms of illness.
- Hypnosis and meditation can play a positive role in healing illnesses.
- Belief, faith, and suggestion all have the power to heal because the mind can change disturbed body functions and reestablish homeostasis.
- A key to maintaining or improving health and wellness is to learn and practice a mental-relaxation technique.
- Image visualization can be used to reduce anxiety and stress, modify behaviors, and enhance performance.
- Virtual reality therapies use computer software to treat phobias and severe pain.

What's New

This edition of *Health and Wellness* has been thoughtfully revised to be more efficient at presenting current health topics (e.g., COVID 19, opioid epidemic, climate change) while maintaining complete presentations of topics in prior editions. Some former chapters were carefully edited and combined: 8–11 were combined to create a new Chapter 8; 17–18 were combined to create a new Chapter 14; 19–20 were combined to create a new Chapter 15; and 21–23 were combined to create a new Chapter 17. Some material (e.g., birth control methods) was linked to authoritative health resources on the Internet (e.g., MedlinePlus). The **Workbook** was moved to the course website.

Instructor Resources

Qualified Instructors will receive a full suite of **Instructor Resources**, including the following:

- Test Bank
- Slides in PowerPoint format
- Lecture Outlines
- Image Bank

Student Resources

- Interactive eBook
- Student Workbook, available in the Navigate course
- Weblinks
- Animations
- Learning Objectives



Reviewers

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Throughout all of the editions of *Health and Wellness*, many people have contributed support and guidance. This book has benefited greatly from their comments, opinions, thoughtful critiques, expert knowledge, and constructive suggestions. We are most appreciative for their participation in this project. We would especially like to thank Brian Luke Seaward, PhD, Paramount Wellness Institute; James Walsh; Esther M. Weekes; Martin Schulz; Shae Bearden; Rocky Young; Bharti Temkin; and Laura Jones-Swann, MEd, LCDC, Texas Tech.

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CHAPTER 1

The Definition of Health



Health Tips

**The Two-Minute
Stress Reducer**



Dollars & Health Sense

**Profiting from Making People Sick
How Much Money Is a Life Worth?**



Global Wellness

Social Factors and Health: The COVID-19 Pandemic

Type 2 Diabetes as a Lifestyle Disease



Managing Stress

Mind–Body Harmony



Wellness Guide

Spirituality and Health

LEARNING OBJECTIVES

1. Describe the medical and wellness models of health.
2. List the key points of the World Health Organization's definition of health.
3. List and describe the six dimensions of wellness.
4. List the three health behaviors responsible for most of the actual causes of death.
5. Define *lifestyle disease*.
6. Identify the goals of *Healthy People 2030*.
7. List and describe the major health issues of college students.
8. Describe the Health Belief Model, Transtheoretical Model, and Theory of Reasoned Action.

Most people think that health is what you have when you are not sick or dying. It's true that not feeling sick is an important aspect of health. Just as important, however, is having a sense of optimal **well-being**—a state of physical, mental, emotional, social, and spiritual wellness. In this view, health is not only being free of disease and disability but also living in harmony with yourself and with your social and physical environments (Sartorius, 2006). You foster your own health and well-being when you:

1. undertake healthy behaviors and practices such as consuming nutritious foods, engaging in daily body movement, attending to your mental and social well-being, and supporting actions that contribute to the health and well-being of your community, and the planet; and
2. refrain from health-harming behaviors (e.g., consuming unhealthy foods, smoking cigarettes, abusing drugs, or becoming overweight) and limit your exposure to health risks (e.g., driving after drinking).

The World Health Organization (WHO) defines health as “a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity.” This definition reflects the old English root of our word health, which is *hal*, meaning well or whole. The WHO definition recognizes that health is affected by the

interrelatedness of the physical, psychological, emotional, spiritual, and environmental influences in people's lives. There is more to health than freedom from sickness. Being healthy also means being able to do what you want to, what you must do at the appropriate time, and being in good spirits and feeling emotionally healthy most of the time.

Jesse Williams (1939), one of the founders of modern health education, echoes the WHO definition by describing health as “that condition of the individual that makes possible the highest enjoyment of life, the greatest constructive work, and that shows itself in the best service to the world. . . . Health as freedom from disease is a standard of mediocrity; health as a quality of life is a standard of inspiration and increasing achievement.”

In this chapter, we discuss the definition of health, how modern lifestyles contribute to an enormous degree of chronic illness throughout the world, and how adopting healthy living habits can help people maintain wellness. Throughout this text, we show you ways to maximize your health by understanding how your mind and body function, how to limit exposure to pollution and toxic substances, how to make informed decisions about health and health care, how to be responsible for your actions and behaviors, and how social, economic, and political forces affect your ability to lead a healthy life. Learning to be responsible for the degree of health and vitality you want while you are young will help ensure lifelong wellness and the capacity to cope with sickness when it does occur.

Models of Health

Scientists and health educators have developed two main ways to define health: the medical model and the wellness model.

The Medical Model of Health

The **medical model** of health's main tenet is that health is the absence of one or more of the “five D’s”—death, disease, discomfort, disability, and dissatisfaction. In other words, if you are not sick, disabled, or mentally unstable or otherwise miserable, you are defined as healthy. The medical model relies almost exclusively on biological explanations of disease and illness and is interpreted in terms of malfunctioning organs, cells, and other biological systems (e.g., liver disease, heart disease, or osteoporosis). In the medical model, the absence of health is determined by the presence of observable or measurable symptoms. In times of sickness, the restoration of health is determined by the successful alleviation of symptoms and hopefully ridding the body of the underlying cause of the disease.



Mind–Body Harmony

When you are well and healthy, your body systems function harmoniously. If one of your organs is not functioning properly, however, the other organs may not be able to function correctly either, and you may become ill. Thus, disease may be regarded as the disruption of a whole person's physical and mental harmony.

In traditional Western science and medicine, mind–body harmony is considered in terms of *homeostasis*, the tendency for coordinated self-regulation among bodily processes that leads to optimal functioning and survival. Many Asian philosophies embody an idea of mind–body harmony. This idea is based on a universal energy called **chi** (or *qi*), which must be distributed harmoniously throughout the mind–body to attain and maintain health. Harmony is expressed as a balance of forces called *yin* and *yang*.

Yin and yang represent the opposing and complementary aspects of the universal chi that is present in everything, including our bodies. Yang forces are characterized as light, positive, creative, full of movement, and having the nature of heaven. Yin forces are characterized as dark, negative, quiet, receptive, and having the nature of Earth.

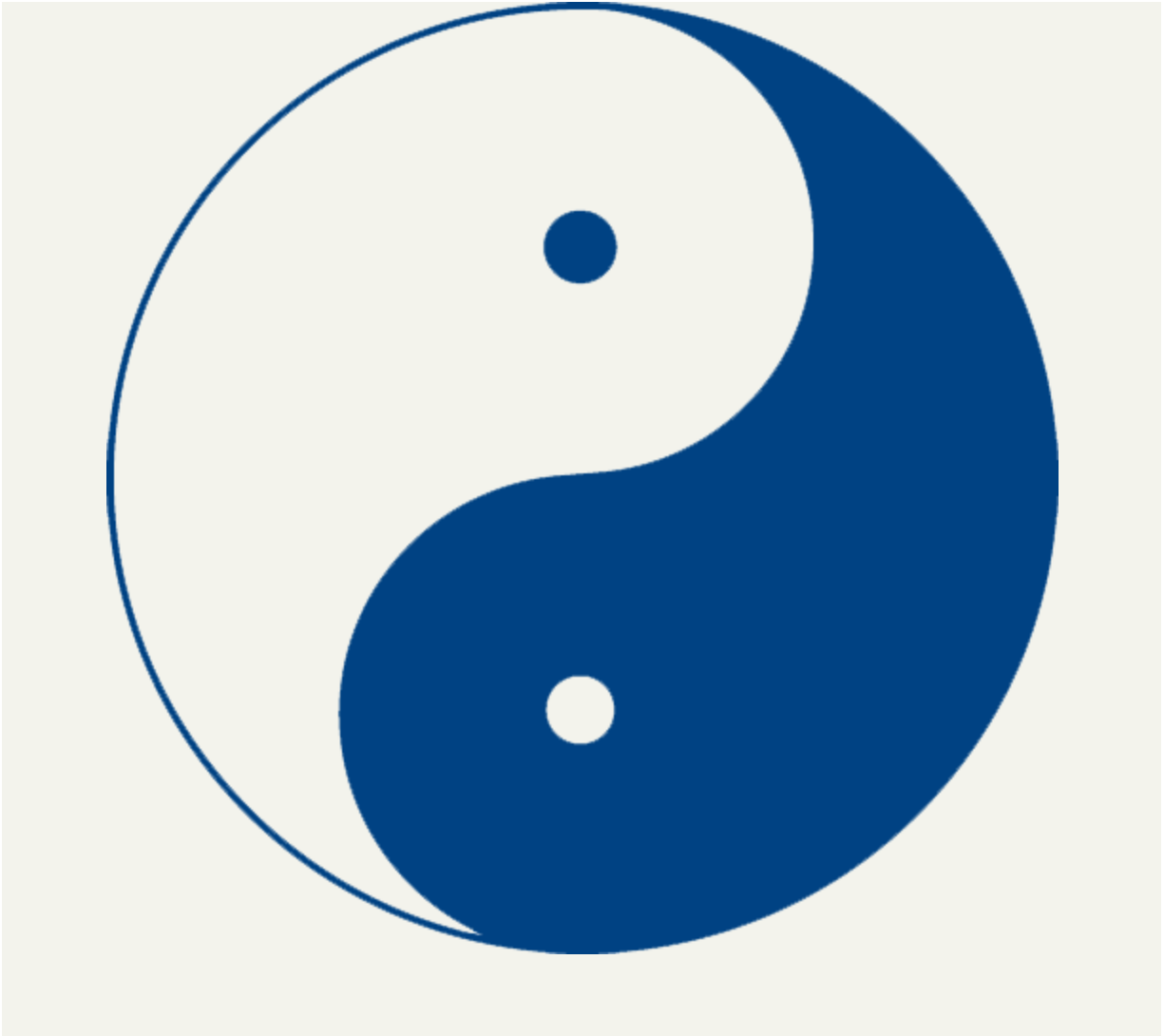
The Yin–Yang Symbol

This symbol represents the harmonious balance of forces in Nature and in people. The white and dark dots show that there is always some yin in a person's yang component and vice versa. The goal in life and Nature, according to the traditional Asian view, is to maintain a harmonious balance between yin and yang forces.

In Asian philosophies and medicine, body and mind are regarded as inseparable. Yin and yang apply to both mental and physical processes. When yin and yang forces are in balance in an individual, a state of harmony exists and the person experiences health and wellness. However, if either yin or yang forces come to predominate in a person, a state of disharmony is produced and disease may result.

Treatment of disease is designed to reestablish harmony of the mind and body. The balance of yin and yang forces must be restored so that health returns.

T'ai chi ch'uan and *qigong* (pronounced jê-kung) are Chinese mind–body methods that are practiced by many North Americans to help maintain health and harmony. These exercises are especially useful for older persons whose bodies can no longer manage vigorous exercise. People who practice *qigong* experience lower blood pressure, improved circulation, and enhanced immune system functions.



The Wellness Model of Health

The **wellness model** emphasizes self-healing, the promotion of health, and the prevention of illness rather than solely treating symptoms of disease. Besides the absence of disease, the wellness model of health encompasses the following dimensions:

Physical wellness: maintaining a healthy body and mind (brain) by consuming nutritious food, attaining near daily manageable amounts of bodily movement, undertaking informed and responsible health practices both to enhance well-being and prevent illness, and seeking competent medical care when ill.

Emotional wellness: understanding, managing, and mindfully expressing your emotions and coping healthfully with life's problems and stresses. Emotional

wellness involves taking responsibility for your behavior, cultivating wisdom, and maintaining a sense of humor.

Intellectual wellness: having a mind open to new ideas and concepts and to access and critically evaluate the veracity of health information. Much of the content of mass media—social media, the Internet, television, and print outlets—refers to health issues. Health practitioners and researchers are trained to assess critically the findings, interpretations, and conclusions drawn from health research, and in the best cases nonprofessionals can receive unbiased explanations of research from professionals they trust and whose goals are to enhance others' health and well-being. However, because its primary goal is profit and not necessarily accurate and unbiased reporting, mass media may skew presentations about health research to capture interest (and to sell products and services) rather than to enlighten and educate (**Figure 1.1**).

Assessing Health and Medical Information

Things to keep in mind when getting information derived from health and medical research:

- What organization or individual is providing the information? What is the provider's stated or implied intention? Assessing the motives of information provided on the internet is especially important because a web site can be made to appear educational when, in fact, its goal is to influence attitudes and behaviors, including purchases.
- What is the information provider's training and expertise? Popular magazine articles often quote scientists and doctors to support the article's thesis. Can you really be sure that the person being quoted is a reliable authority?* What is the source of the data in the research? Is the information

based on an observer's experience, a survey, or a study comparing a "treatment" group with a group of "matched controls."

- Who Benefits? What benefits is the source of the information receiving for communicating it. You want to avoid being manipulated by bias presented in the guise of scientific truth.

Occasionally, a study's results are described as *statistically significant*, which means that an observation, or a comparison of observations, is highly likely not to be the result of mistakes made by researchers or to have occurred by chance. Findings are statistically significant if a mathematical analysis of the data show a very small — or *insignificant* — chance that the findings from this analysis are wrong. Scientists generally are willing to accept a finding as true if the chance it is wrong is less than 1 in 20 (reported as $p = 0.05$).

Figure 1.1 Certain Things Should be Kept in Mind When Getting Information Derived from Health and Medical Research.

Description

Social wellness: striving for healthy and harmonious interactions with others including family, friends, intimate-partners, classmates, neighbors, and the larger local and world communities. Social wellness involves effectively communicating thoughts and ideas to others and receiving with acceptance and tolerance the thoughts, ideas, and emotional expressions of others, including those who are different from yourself. Social wellness also includes managing your time and activities effectively.



Spirituality and Health

Many people find that spirituality—experiencing hope, comfort, and inner peace through religion, a connection with Nature, or a force larger than oneself—plays a role in health and illness. Spiritual experiences tend to engender feelings of compassion and empathy; peace of mind; relatedness and communion; and harmony with the environment. Spirituality can be a cornerstone of health because it represents a balance between the inner and outer aspects of human experience. For some, the spiritual dimension of life is embodied in the practice of a specific religion. For others, the spiritual dimension is nonreligious yet part of a personal philosophy. Many practices can help people experience the spiritual realms of existence, including prayer, meditation, yoga, musical and artistic endeavors, and helping others.

Becoming more spiritually aware, regardless of the chosen path, can lead to a healthier life. Being in touch with your spiritual feelings helps you handle life's ups and downs with understanding and compassion for yourself and others. You become open to love in the highest sense of its meaning, which is acceptance and tolerance. You begin to love yourself despite your problems and hang-ups. You love your family and friends when relations are strained. You see beauty and harmony in more and more aspects of living. And occasionally—however fleetingly—you may experience the truly wondrous feeling of being completely and joyfully alive.

Spiritual wellness: a state of harmony within yourself, with other people, and with a deity or Nature. Most often spiritual wellness involves a sense of identifying with a beneficent group, philosophy, or a religious practice that is larger than yourself. Spiritual wellness also includes positive and helpful personal values and beliefs, seeking meaning and purpose in life, practicing compassion, and appreciating natural forces in the universe.

Occupational wellness: finding satisfaction, creativity, and a sense of accomplishment in what you do to earn a living, to contribute through your work to making a healthy society and world and creating a balance among work activities and other aspects of life.

Environmental wellness: living in an environment characterized by clean air, water, and land that also supports basic human needs and is free of interpersonal violence and the threat of climate change.

Financial wellness: attaining and maintaining resources to meet physical, psychological, and social needs, including planning for the future and preparing for unforeseen financial difficulties (“Hope for the best, plan for the worst.”), and being aware of others’ financial values, needs and circumstances.

“The health of a people is really the foundation upon which all their happiness and all their powers as a state depend.”

—**Benjamin Disraeli**, former Prime Minister of England



The Two-Minute Stress Reducer

Stressed out?

Be still.

And take a

D

E

E

P

Breath.

Center Yourself

Focus your attention inward. Allow thoughts, ideas, and sensations to pass through your mind without reacting to any of them. You will notice them pass out of your mind, only to be replaced by new thoughts and sensations. Continue to breathe deeply and slowly and watch the passing of the thoughts that stress you.

Empty Your Mind

Acknowledge that you have preconceived ideas and ingrained habits of perceiving. Know that you can empty your mind of distressing thoughts and replace them with ones that create inner harmony.

Ground Yourself

Feel the sensation of your body touching the Earth. Place your feet (or your bottom if you are sitting, or your entire body if you are lying down) firmly on the Earth. Let your awareness come to your point of contact with the Earth, and feel gravity connecting you to Mother Earth and stabilizing you.

Connect

Allow yourself to feel your physical and spiritual connection with all living things. Remind yourself that with every breath you are reestablishing your connection with all of nature.

Health is not something suddenly achieved at a specific time like graduating from college. Rather, health is a lifelong process through which you develop and encourage every aspect of your body, mind, and spirit to interrelate harmoniously as much as possible. Almost every choice we make in life can potentially affect our health and well-being. Sometimes the social and physical environments present obstacles to making healthful choices. For example, a person may know not to eat fatty fast food every day, but this kind of food may be easier to obtain than healthier alternatives. Wellness includes recognizing that some social influences are not healthy and finding healthier alternatives. It also includes taking actions to make the social and physical environments healthier for all.

Determinants of Health and Wellness

Determinants of health and wellness consist of personal, social, economic, and environmental factors that affect individual, community, and world health. The main determinants of health include the following: personal biology, economic and social status, environmental attainment, environmental quality, and individual behaviors.

Personal Biology

Personal biology is a manifestation of one's genetic endowment and life experiences that affect the body throughout the life course. The genetic endowment consists of the many thousands of genes inherited from parents that determine the body's structure and function (see Chapter 12). Malfunctioning genes can cause serious, life-altering inherited diseases such as sickle cell disease, cystic fibrosis, or breast cancer (Genetics, 2020). Long-lasting or permanent change to one's personal biology can result from infections, accidents, or acts of violence that result in impaired mobility, mental processes, hearing, and vision and that significantly alter one's life in other ways (U.S. Centers for Disease Control and Prevention, 2019).

Some 12% of Americans have had *adverse childhood experiences* or ACEs (divorce, abandonment, rejection, parental substance abuse, sexual abuse, and neglect) (**Table 1.1**). Four or more ACEs are associated with a proportional increased risk for mental and physical ill health throughout life and early death (U.S. Centers for Disease Control and Prevention, 2021). Attempting to cope with the mental health consequences of ACEs, such as anxiety and depression, can lead to unhealthy lifestyle behaviors such as overeating or consuming unhealthy foods, substance abuse, poor sleep, and lack of physical activity (Felitti, 2009). Recovery from the traumas of ACEs is possible with a personal intention to heal,

therapist-guided mental and physical exercises, and the support of caring others.

TABLE 1.1 | **Adverse Childhood Experiences (ACEs) Questionnaire**

Four or more experiences carry a proportional risk for ill health as an adult. Numbers in parentheses indicate percentage affected in the original ACE study population.

Category	Examples
Abuse	<p>Emotional abuse: A parent, stepparent, or adult living in your home swore at you, insulted you, put you down, or acted in a way that made you afraid that you might be physically hurt. (10.6%)</p> <p>Physical abuse: A parent, stepparent, or adult living in your home pushed, grabbed, slapped, threw something at you, or hit you so hard that you had marks or were injured. (28.3%)</p> <p>Sexual abuse: An adult, relative, family friend, or stranger who was at least 5 years older than you ever touched or fondled your body in a sexual way, made you touch his or her body in a sexual way, or attempted to have any type of sexual intercourse with you. (20.7%)</p>
Household Challenges	<p>Mother treated violently: Your mother or stepmother was pushed, grabbed, slapped, had something thrown at her, was kicked, bitten, hit with a fist, hit with something hard, repeatedly hit for more than a few minutes, or ever threatened or hurt by a knife or gun by your father (or stepfather) or your mother’s boyfriend. (12.7%)</p> <p>Substance abuse in the household: A household member was a problem drinker or alcoholic or a household member used street drugs. (26.9%)</p> <p>Mental illness in the household: A household member was depressed or mentally ill or a household member attempted suicide. (19.4%)</p> <p>Parental separation or divorce: Your parents were separated or divorced. (23.3%)</p> <p>Incarcerated household member: A household member went to prison. (4.7%)</p> <p>Emotional neglect: No one in your family helped you feel important or special, you did not feel loved, people in your family did not look out for each other nor felt close to each other, and your family was not a source of strength and support. (14.8%)</p> <p>Physical neglect: There was no one to take care of you, protect you, and take you to the doctor if you needed it, you did not have enough to</p>

eat, your parents were too drunk or too high to take care of you, and you had to wear dirty clothes. (9.9%)

U.S. Centers for Disease Control and Prevention, Kaiser Permanente. The ACE Study Survey Data [Unpublished Data]. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 2016.
<https://www.cdc.gov/violenceprevention/childabuseandneglect/cestudy/about.html>

Economic and Social Status

Economic determinants of health include resources to meet life's needs, such as healthy food, an adequate education, a good-paying job, living in clean and safe surroundings, and access to quality medical care. Social determinants also include social support and community cohesion. Social and economic determinants of health are greatly affected by discrimination by race, sex, gender, and social status (see the Global Wellness box "Social Factors and Health: The COVID-19 Pandemic").

Environmental Attainment

Educational attainment has a major effect health and wellness (Zajacova & Lawrence, 2018). For example, educational attainment is highly related to income and employment, which facilitate access to the basics of health and wellness: nutritious food, living in a healthy and safe environment, and having access to competent medical care when needed. Furthermore, education can facilitate accessing and utilizing health and medical information to promote living healthfully.

Environmental Quality

Environmental determinants of health are both natural and human-made (called the *built environment*). Natural environmental determinants of health include the quality of air, water, land, and the risks of harsh weather and climate change. The built environment includes buildings, homes, neighborhoods, transportation options,

recreational settings, and exposure to toxic substances and other physical hazards. For example, millions of people in cities around the world are exposed to unhealthy levels of ozone and other air pollutants from automobile and power-plant emissions, thus increasing their risk of asthma and other respiratory conditions.



Social Factors and Health: The COVID-19

Pandemic

The COVID-19 pandemic provided a horrific example of social factors affecting health. Among the sickest and those who died, social factors such as race, income, education, and access to health care explained the stark differences found in trauma related to COVID-19. Long-standing social inequities influenced a wide range of health and quality-of-life risks and outcomes (listed below) that, along with racism and its associated chronic stress, contributed disproportionately to being affected by COVID-19.

- **Social Determinant 1, Neighborhood and Physical Environment:** Where and how people live are major risk factors for COVID-19 infection and its catastrophic consequences. For example, low income can force people to reside in crowded living spaces or crowded neighborhoods that can inadvertently expose them to others who are infected. Low-income neighborhoods may lack reliable transportation to employment, health, and medical services. Stores offering healthy foods may be rare. Living near freeways and industrial plants expose residents to environmental pollution.
- **Social Determinant 2, Health and Medical Care:** Low income, joblessness, and racial segregation can contribute to lack of access to quality health care, health insurance, or linguistically and culturally responsive health care. Inequities in treatment may result in distrust of government and healthcare systems. Such barriers increase risks for poor health and health outcomes by limiting health promotion, disease and injury prevention, and condition-management practices.
- **Social Determinant 3, Occupation and Job Conditions:** Essential workers—those employed in healthcare facilities, farms, factories, food production and processing, grocery stores, and public transportation—have increased risk of exposure to COVID-19. Their jobs generally require frequent or close contact with the public or other workers, involve activities that cannot be done from home and worksites that are not equipped with protective equipment and are not willing or able to make adjustments in working conditions to limit exposure to COVID-19. Also, they may have jobs that do not offer paid sick days, so they feel compelled to work in order to maintain an income even if infected.

- **Social Determinant 4, Income and Wealth:** Low income often means having significant debt and difficulty managing expenses, paying bills (including medical bills), and accessing affordable quality housing, nutritious food, and reliable child care.
- **Social Determinant 5, Education:** Low proficiency in speaking and reading English make it more difficult to obtain and understand health information and to follow written materials intended to help lessen COVID-19 risk. Lower levels of educational attainment create barriers to quality job training and college entrance.

Disproportionate exposure and subsequent devastating health consequences from COVID-19 infection magnified the harm engendered by the unequal availability of social resources needed to ensure the health and well-being of all individuals.

Data from U.S. Centers for Disease Control and Prevention (2020). COVID-19 Racial and ethnic health disparities. (<https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/racial-ethnic-disparities/index.html>).

Individual Behaviors

In regions of the world without vaccination, modern sanitation, and effective forms of infection and infestation control, people are at risk for a variety of diseases caused by viruses, bacteria, parasites of various kinds, and worms. COVID-19, tuberculosis, malaria, and Ebola are examples. These diseases account for 50% of annual deaths worldwide, principally in economically challenged regions.

Because of high-quality sanitation and medical care, with the exception of COVID-19 and other unexpected pandemics (see Chapter 9), residents of high- and moderate-income countries are at minimal risk for many kinds of fatal infections and infestations. Instead, these individuals are at risk for **lifestyle diseases** resulting from personal behaviors such as cigarette smoking; consuming too little fruits, vegetables, and whole grains and high levels of processed meats and industrial food products laden with added sugar and salt; and a sedentary lifestyle. Heart disease, for example, results primarily from poor diet consisting of highly processed manufactured foods, cigarette smoking, lack of exercise, high levels of stress, and high blood pressure (Mozaffarian & Glickman, 2019). Cancer is associated with poor nutrition, tobacco smoking, and exposure to hazardous substances in the environment. Other lifestyle diseases include lung disease from tobacco smoking, type 2

diabetes, and kidney disease from being overweight (see the Global Health box “Type 2 Diabetes as a Lifestyle Disease”), and suicide, homicide, and fatal accidents from stress and alcohol and substance abuse. Eight of the top 10 causes of death in the United States and Canada are from lifestyle diseases (**Table 1.2**).

TABLE 1.2 | **Top 10 Causes of Death in the U.S and Canada, 2019**

Disease	Rank	
	U.S.	Canada
Heart disease*	1	2
Cancer*	1	2
Accidents (unintentional injuries)*	3	3
Chronic lower respiratory diseases	4	5
Stroke (cerebrovascular diseases)*	5	4
Alzheimer’s disease	6	8
Diabetes*	7	6
Nephritis, other kidney disease	8	7
Influenza and pneumonia	9	10
Intentional self-harm (suicide)*	10	9

*Indicates lifestyle disease

Data from U.S.: National Center for Health Statistics

<https://www.cdc.gov/nchs/fastats/leading-causes-of-death.htm>. Canada: Statistics Canada

<https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1310039401>

Many lifestyle diseases are **chronic diseases**, meaning that they often persist for life, with ever-increasing dependence on the medical system and gradual lessening of the quality of life. Worldwide, between 50% and 60% of health expenditures are for treatment of chronic diseases that are largely preventable by changes in unhealthy living habits. Whereas at some level each individual is responsible for her or his lifestyle decisions, scientists and health professionals know that community, state, national, and international efforts are needed to help individuals make healthy lifestyle choices (see the previous Global Wellness box on COVID-19). For example, schools and businesses can encourage food services to provide healthy items. The stairwells of office buildings can be made visually attractive to encourage walking stairs instead of riding elevators. Businesses can organize group walks for employees during breaks; they can also offer financial incentives for adopting healthy living habits. Municipalities can ensure that new subdivisions have sidewalks, bike lanes, and parks. Governments can impose taxes on health-harming products (e.g., sugar-sweetened drinks and tobacco products) to reduce consumption, insist that consumers be made aware of the content and risks of manufactured foods, and be ever watchful that manufacturers ensure food and product safety. Governing bodies can create laws that enhance individual and public safety—for example, cleanliness in food manufacturing, ordinances prohibiting smoking in public spaces, and fuel efficiency standards for fossil fuel powered vehicles.



Type 2 Diabetes as a Lifestyle Disease

Diabetes is a disease in which the amount of sugar in the blood increases to unhealthy levels as a result of malfunctions in the body's sugar-regulating system. There are two forms of diabetes:

1. **type 1 (insulin-dependent)** in which the pancreas (a digestive organ) is diseased and unable to manufacture the hormone insulin, which regulates the level of sugar in the blood; and

2. **type 2 (non–insulin-dependent)**, which is caused by too much fat in the blood (generally from being overweight) and results in the body becoming resistant to the actions of insulin (*insulin resistance*).

In 2021, approximately 8.5 % of the world's population—463 million individuals—were affected by type 2 diabetes. Type 2 diabetes is a major cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputation. About 10% of North American population has type 2 diabetes. Worldwide, type 2 diabetes is responsible for approximately 4 million deaths each year, making it the seventh leading cause of death in the world. The disease affects people of all ages and males and females equally. The global prevalence of type 2 diabetes is projected to increase to 700 million individuals by 2045.

The global epidemic of type 2 diabetes is considered to be the result of rapid worldwide economic development and urbanization in the last part of the 20th century. When people moved to cities for work, their living habits changed from consuming traditional diets that were somewhat balanced and moderate amounts of body movement to the consumption of unhealthy, processed, manufactured, and fast foods and a sedentary lifestyle. This is the reason type 2 diabetes is strongly associated with being overweight (Khan, Hashim, King, & Kahn, 2019). For every 20% increase in overweight, the chance of developing type 2 diabetes doubles. Type 2 diabetes is costly and often medically challenging to treat. Rather than drugs to control the medical consequences of type 2 diabetes, it is better for patients to eat healthfully and to engage in regular body movement (Nutrition Source, 2020). As shown in China, Finland, India, Japan, and the United States, community-based health programs are an effective way to help individuals prevent the onset of type 2 diabetes (Shirinzadeh, Afshin-Pour, Angeles, Gaber, & Agarwal, 2019). These programs offer individual and group-based educational sessions to help persons attain a healthy diet and incorporate movement and stress reduction activities into their lives.

World Diabetes Day is November 14 (<https://worlddiabetesday.org/>).



Profiting from Making People Sick

Heart disease, stroke, lung cancer, colon cancer, type 2 diabetes, and chronic obstructive pulmonary disease account for nearly half of all deaths in the United States. These diseases are caused in large part by unhealthy lifestyle choices: eating poorly, smoking cigarettes, being overweight, and not exercising. Unfortunately, many businesses profit from individuals' unhealthy lifestyles—indeed, some encourage unhealthy behavior as the basis of their business (Allen, 2019).

The tobacco industry is the prime example of profiting financially from harming others. No other industry makes a product that, when used as directed, causes disease and death. Knowing that long-term smokers (i.e., their best customers) tend to begin smoking

as teens, the tobacco industry uses sophisticated marketing methods to lure young people to smoke and to get them hooked. The tobacco industry is a friend to no one.

Whereas it is not as obvious as with tobacco, some food companies also profit from harming their customers. A typical serving of fast food (e.g., burger, fries, and a soft drink or shake) contains around 1,000 calories, about half or more of most individuals' energy requirement for one day. This is why a steady diet of fast food can lead to weight problems and associated illnesses like type 2 diabetes.

Some of America's largest corporations are in the business of supplying consumers with less-than-healthy amounts of sugar (**Figure 1.1A**). The sugar is contained in packaged foods (from ketchup to breakfast cereals), snack foods, fast foods, and sugar-sweetened beverages such as sodas, energy drinks, and sports drinks. Sugar-sweetened beverages alone deliver 36% of the added sugar that Americans consume, contributing to the risk of heart disease and type 2 diabetes. And, unlike other products to which sugar is added, sugar-sweetened beverages have no nutritional value; they can readily be replaced by healthy beverages such as water and low-fat milk. Efforts to limit the damage to health from added sugar in food include taxing sugar-sweetened beverages to lessen consumption, particularly among youth, and encouraging food companies to voluntarily reduce the amount of sugar added to their products.

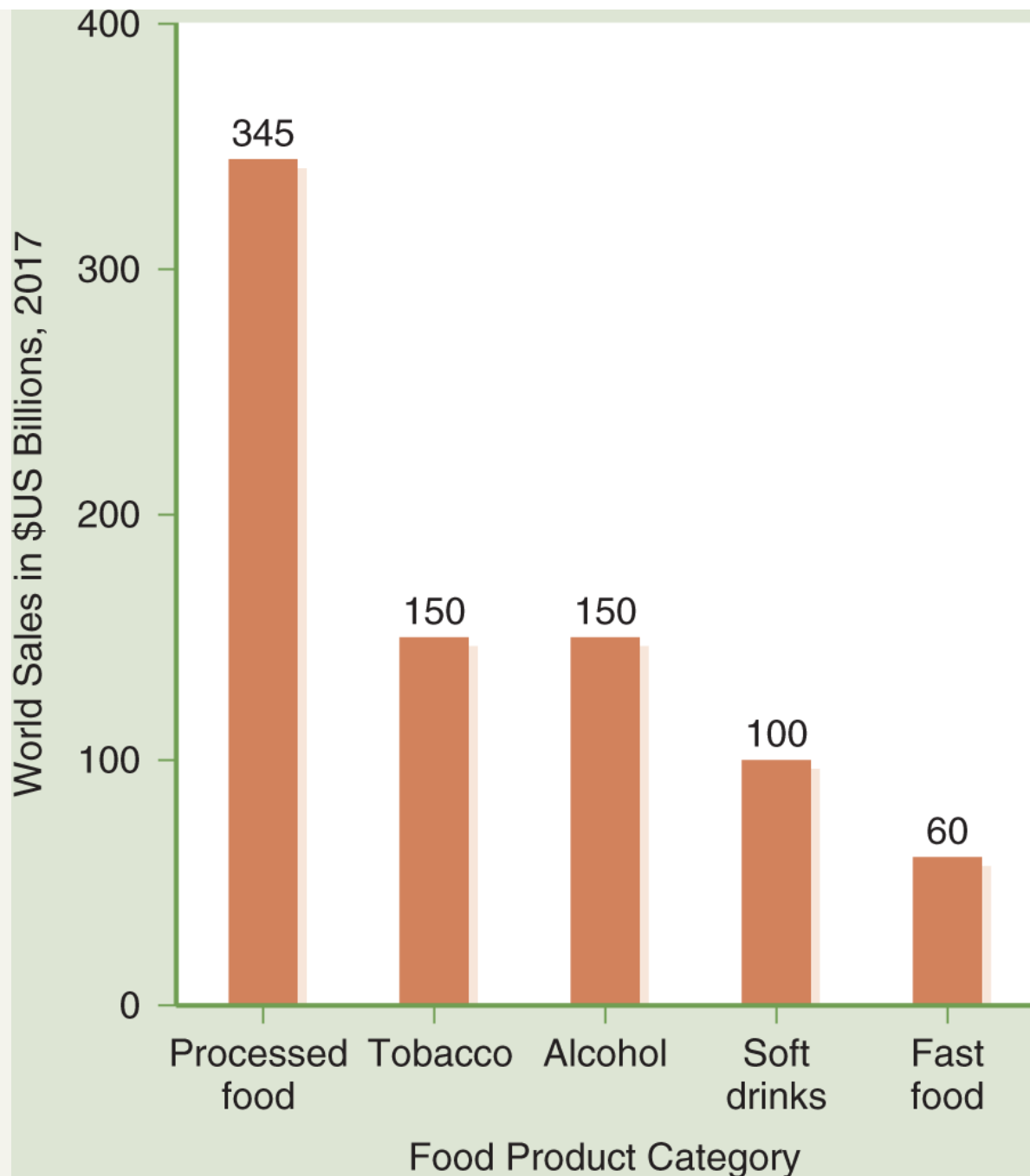


Figure 1.1A Sales Figures for 33 Leading Transnational Corporations in 2017 by Sector.
Description

You need not wait for the actions of government and industry to better your health. You can start today by adopting healthy living habits, being mindful of others attempts to profit from distributing ill health, and being especially wary of health, medical, and pharmaceutical drug advertising.

Health Status

Health status is an individual's state of health and wellness, taking into account the presence of disease, disability, and the individual's self-rated assessments of her or his overall physical, mental, and social health and the degree of meaning and purpose in his or her life (VanderWeele, 2019) (**Figure 1.2**). Note that some people perceive themselves as healthy despite having one or more chronic diseases, and others perceive themselves as ill when no biological evidence of disease can be found.

Category	Description
Mental & Physical Health	Self-rated degree of physical and mental health
Financial Status	Self-rated concern about being able to meet normal living expenses
Happiness	Self-rated degree of current satisfaction with life
	Self-rated usual sense of happiness/unhappiness
Meaning & purpose in life	Self-rated extent that life activities are worthwhile
	"I know my purpose in life."
Close personal relationships	Contentment and satisfaction with current relationships and friendships
Character	Strive to promote good in all (even challenging) situations
	Willingnesss to forego some happiness in the present for greater happiness in the future

Figure 1.2 Components of Health and Well Being.

Data from VanderWeele, T.J. (2019). Reimagining Health “ Flourishing. *Journal of the American Medical Association*, 321, 1667–1668.

Description

Optimal health and well-being include mental and physical health, happiness and life satisfaction, meaning and purpose, character and virtue, and close social relationships.

Health status can be scientifically measured (Figure 1.3). Some methods assess the status of a group, such as people living in a particular region, people of a certain age, or people with a certain disease or disability. The incidence of a given health condition refers to the number of people in a group who experience that condition in a given period of time, usually a year (e.g., “The incidence of breast cancer in the United States is 200,000 cases per year”). The prevalence of a given health condition is the total number of people in a group affected by that condition at the time of measurement (e.g., “In 2019, the prevalence of breast cancer among American women is 128 per 100,000 women”).

Measuring Method	What is Measured
Years of Potential Life Lost (YLL)	Total number of years not lived by people who die for whatever reason before reaching a given age.
Disability Adjusted Life Years (DALYs)	Total number of years lived with illness or disease limits life in some way.
Physically and Mentally Unhealthy Days	Reported for the prior 60 days.

Chronic Disease Prevalence	Reported for either cardiovascular disease, arthritis, diabetes, asthma, cancer, and chronic obstructive pulmonary disease (COPD).
Limitation of Activity	Due to physical, mental, or emotional problems
Self-assessed Health Status	Individual perception of his or her health rated as excellent, very good, good, fair, or poor.
Health Related Quality of Life	An individual's or a group's perceived physical and mental health over time and the impact of preventable diseases, injuries, and disabilities on the quality of life.

Figure 1.3 Scientific Measures of Health Status.

Description

You can observe a lot just by watching.
Yogi Berra

Health: United States

For decades the United States has been the wealthiest nation in the world. Given this wealth and the fact that in the last 100 years, more U.S. scientists have been awarded the Nobel Prize in physiology and medicine than any other country, the health status of the American population is far lower than nearly all countries of equivalent income (e.g., Australia, Canada, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Switzerland, and the United Kingdom) ([Figure 1.4](#)).

Health Measure	U.S. Rank
Life expectancy from birth in years	12th
Maternal mortality (%/100,000)	12th
Infant mortality (%/1000 live births)	12th
Mortality rate (deaths/yr/100,000 population)	12th
Premature deaths (YLL)***	12th
Years living with disease (DALYs)****	12th
Doctors/1000 population	11th
Spending on pharmaceuticals & medical devices	1st
Percent with some health insurance	12th

Daily smokers	12th
Death rate for poor mental health and substance abuse	1st
Alcohol consumption (liters/person/yr)	5th
Percent with Alcohol Abuse Disorder	2nd
Opioid deaths/1 million inhabitants (2018)	1st
Percent overweight/obese	1st
Percent overweight children	1st
Air pollution deaths/yr	3rd
Heart Disease mortality/100,000 persons	1st
Stroke mortality/100,000 persons	7th
Cancer incidence/100,000 persons	2nd
Cancer mortality/100,000 cases	5th
Diabetes prevalence/100,000 persons	1st
Suicide/100,000 persons	2nd
Self-rated health	
% bad or very bad	12th
% good or very good	2nd

Source: Organization for Economic Development and Cooperation (2019) *Health at a Glance*. 2019: OECD Indicators. Paris: OECD Publishing, Paris, <https://doi.org/10.1787/4dd50c09-en>.

Figure 1.4 Health Care Quality Comparisons Among High Income Countries. With regard to a variety of measures of health, the United States consistently ranks well below these high-income countries: Australia, Canada, France, Germany, Italy, Japan, Netherlands, Norway, Spain, Switzerland, and the United Kingdom.

Data from "Health at a Glance, 2019." OECD Indicators. Paris: OECD Publishing.
<https://doi.org/10.1787/4dd50c09-en>

Description

Compared to individuals in peer countries, Americans have shorter life expectancy, more mothers dying when giving birth, and more people with chronic diseases such as high blood pressure, cancer, and diabetes. This incongruous situation is so even though annual per-person expenditures for medical care in United States far exceed those for individuals living in peer nations (**Figure 1.5**).

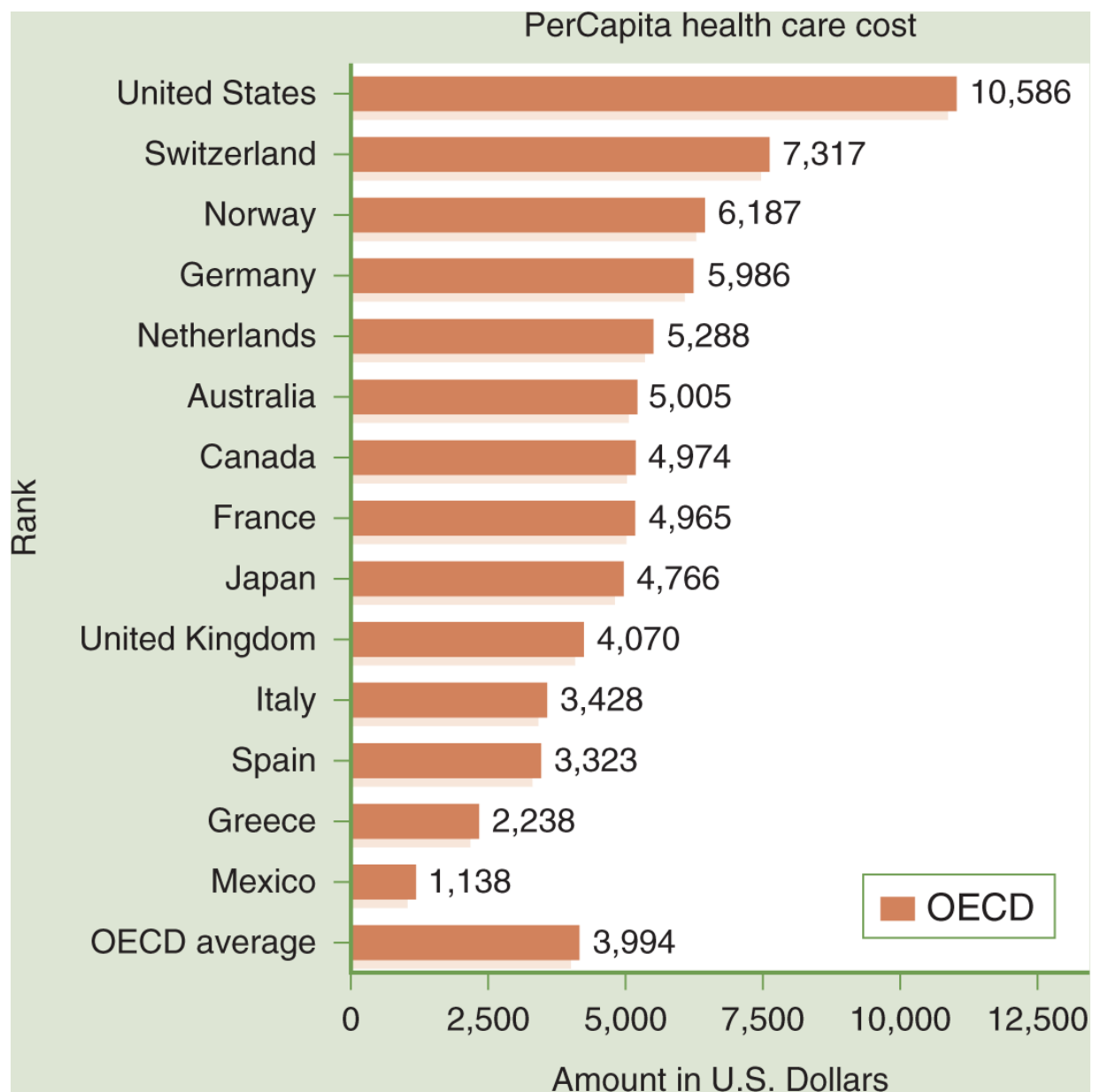


Figure 1.5 Healthcare Cost Comparison Among High Income Countries.

Data from OECD (2019), *Health at a Glance 2019: OECD Indicators*, OECD Publishing, Paris, <https://doi.org/10.1787/4dd50c09-en>

OECD is the Organisation for Economic Co-operation and Development, [oecd.org](https://www.oecd.org)

Description

Some of the reasons healthcare costs are greater in the United States than in peer countries include the following:

- In most other high-income countries, there is little or no personal cost for medical care, including pharmaceuticals. In contrast, many Americans encounter financial barriers to accessing medical care because they lack health insurance or cannot afford co-pays and medicines with the insurance they do have.
- A 2019 study conducted by the Ways and Means Committee of the U.S. House of Representatives revealed that the average per-person cost of pharmaceuticals in the United States—about \$1,200 per year—is twice that of peer countries. Other than the United States, every high-income country negotiates prices with pharmaceutical manufacturers, thereby ensuring the lowest costs. In 2000, the U.S. Congress made negotiating drugs prices illegal, except for the Veterans Administration. Therefore, in the United States, drug companies can charge whatever they want for medicines—and do! (See [Table 1.3.](#))

TABLE 1.3 Cost Comparison of Some Prescription Drugs

Drug	Cost (\$USD)			
	United States	Canada	India	United Kingdom, Australia, New Zealand
Celebrex (200 mg)	13.72	1.91	1.05	0
Paxil (20mg)	6.83	2.98	0.98	0
Nexium (40mg)	7.78	3.37	0.35	2.21
Viagra (100mg)	58.72	10.77	4.44	8.31
Nasonex (50mcg)	648.00	132.53	50.00	113.92

Data from U.S. Drug Prices vs. the World (2019). DrugWatch. <https://www.drugwatch.com/featured/us-drug-prices-higher-vs-world/>

Description

- Many Americans have unhealthy living habits, consuming low-quality foods, which predisposes them to being overweight or obese; abusing alcohol and other drugs; being less likely to use

seat belts; being involved in traffic accidents that involve alcohol; and using firearms in acts of interpersonal violence and suicide (Mokdad et al., 2018).

- Although Americans’ average income is higher than those in peer countries, the United States also has higher levels of poverty (especially child poverty), income inequality, lower rates of social mobility, and lower levels of educational attainment. These economic and social disparities create **health disparities**—that is, differences in health status based on race, income, educational attainment, and access to healthy food, healthy environments, and quality medical care (**Table 1.4**).

TABLE 1.4 | **Effects of Income Inequality on Health Measures of U.S. Adults (2018) in Percentages**

Health Measure	Income Level*		
	Low	Medium	High
Insufficient exercise	53.5	43.2	32.0
Limitation from chronic diseases	24.3	12.4	7.1
Self-rated <i>poor</i> health status	22.9	11.2	5.0
Current cigarette smoker	22.3	14.0	7.1
No health insurance	20.2	11.5	4.2
Nervous or distressed	18.8	9.2	1.6
Sad, hopeless, worthless (depressed)	15.8	7.4	2.3
Emphysema or bronchitis	8.0	4.8	2.8

*Low income = <\$35,000/yr.; medium income = \$50,000–\$75,000/yr.; high income = >\$100,000/yr.
 Data from U.S. Centers for Disease Control and Prevention, National Health Interview Survey, Summary Health Statistics Tables P-1a, P-11a, A-7a, A-8aA-11a, A-12a, A-14a, 2018. <https://www.cdc.gov/nchs/nhis/SHS/tables.htm>

Description

- U.S. communities and the built environment are more likely than those in peer countries to be designed around automobiles, which discourages physical activity and increases exposure to air pollution from auto emissions.

Healthy People 2030

Each decade, the U.S. government issues a set of health objectives for the nation to be accomplished in the ensuing 10 years. The current set of health objectives is called *Healthy People 2030* ([Healthypeople.gov](https://www.healthypeople.gov)). The main goals of *Healthy People 2030* are to:

- promote, strengthen, and evaluate the nation's efforts to improve the health and well-being of all people;
- eliminate health disparities, achieve health equity, and attain health literacy to improve the health and well-being of all;
- provide data that can drive targeted actions to address regions and populations with poor health or at high risk for poor health in the future; and
- distribute across national, state, tribal, and community levels and public, private, and not-for-profit sectors responsibility for promoting and achieving health and well-being and to develop and make available financially affordable means of health promotion, disease prevention, and treatment.



How Much Money Is a Life Worth?

When U.S. federal agencies consider adopting new regulations intended to promote health or prevent injury or death, they try to figure out if the new regulations will be cost-effective and whether the gain in health is worth the cost to attain it.

For example, let's assume that of the several thousand water systems in the United States, 2,000 would have to spend a combined total of \$3 billion to modernize so that arsenic levels could be reduced to required (safe) levels. Let's also assume that spending this \$3 billion would save the lives of 60 people per year who would otherwise

die of arsenic toxicity. If the costs of modernizing the water systems were spread over 20 years, then the \$3 billion would save $20 \times 60 = 1,200$ lives. That works out to \$2.5 million per life saved.

Is the new regulation worth the cost? Most definitely, according to *value of a statistical life* (VSL) calculations used by most federal agencies. Although each agency has its own specific VSL, the values for early and middle-aged adults tend to be between \$6 million and \$9 million per life; the VSL for someone age 65 or older is about half that for someone in middle age. The VSL represents how much a person or employer is willing to pay to greatly reduce or eliminate a fatal risk. It is not based on earning power, an estimate of one's contribution to society, or how much someone is loved by family and friends.

It's been pointed out that \$6 million to \$9 million per life seems reasonable until you're talking about yourself or someone you care about. Then, the dollar value of a life is close to infinite.

To attain its main goals, *Healthy People 2030* identifies hundreds of specific health objectives. Examples of *Healthy People 2030* objectives include the following:

- Reduce consumption of calories from added sugars in the population aged 2 years and older.
- Reduce the proportion of persons who are unable to obtain or delay in obtaining necessary medical care.
- Reduce firearm-related deaths.
- Increase the proportion of retail food store delis where foods displayed or stored hot are held at the proper temperature.

Healthy People 2030 recognizes that families, schools, worksites, communities, states, and national organizations must help individuals behave healthfully. This means not only that individuals are asked to make healthy lifestyle choices based on sound health knowledge but also that communities and organizations strive to provide quality education, housing, and transportation; health-promoting social and physical environments; and access to quality medical care. For example, informing people that it is healthy to consume five servings of fresh fruits and vegetables each day is insufficient if their community does not have stores or other sources

of healthy food. Also, advising people to walk more is insufficient if their communities are not safe or lack parks or sidewalks.

Health Issues of North American College Students

About 23 million people attend North American colleges and universities. Two-thirds of those students are under 25 years of age. Among the most common health issues reported by North American college students are insufficient exercise, less-than-recommended consumption of fruits and vegetables, stress, and haphazard contraceptive use (Table 1.5).

TABLE 1.5 **Common Health-Related Issues Reported by American College Students (Percentage)**

Health-Related Issue	Male	Female
Not meeting movement activity guidelines	25	31
Daily consumption >1 sugar-sweetened beverage	65	67
Daily consumption <3 servings fruits or vegetables	52	51
Tanning >1 time in previous 12 months	41	63
Not having dental exam in previous 12 months	25	25
Contraceptive use in previous vaginal intercourse	88	89
Sexual abuse or assault in prior year	6	19
Intimate partner abuse, violence in prior year	17	19
Allergies (pollen, grass. pets)	37	49
Overweight (BMI >25)	37	34
Human papilloma vaccination	49	62

Health-Related Issue	Male	Female
Cold or flu	41	58
Urinary tract infection	1	15
4+ sexual partners in previous year	16	14
Psychological distress	38	43
Loneliness	48	51
Challenges with procrastination	72	73
Challenges with academics	44	47

American College Health Association, 2020.

Some typical health issues facing college students include the following:

Mental health. Students are exposed to a variety of stressors and pressures that can impair their mental health. Academic overload, tests, and competition can create feelings of insecurity, anxiety, inferiority, and depression. Traditional students may be lonely and have difficulty adjusting to early adulthood. Nontraditional students may feel isolated and without social support. Stress can impair sleep and lead to depression.

Food and weight. Time pressures and the easy availability of junk food induce many students to consume lots of sugar (candy, sodas) and saturated fat (fast food) and insufficient amounts of fruits and vegetables. Students may use food to cope with stress and uncomfortable emotions. Many students are overly concerned about their body size and shape to meet social expectations of attractiveness, causing some to develop eating disorders. Many college students are among the two-thirds of North American adults who are overweight. Thus, weight control is an issue for many students.

Health care. A large proportion of U.S. college students has limited access to health care because their colleges do not have comprehensive services and they are without health insurance.

Substance use and abuse. Many students use tobacco, vaping, alcohol, and other drugs to cope with stress and unpleasant feelings or to fit in socially. Alcohol abuse is related to sexual assault and date rape, unintended pregnancies (from

not using contraceptives properly or at all) and acquiring a sexually transmitted disease (STD) from not practicing safer sex.

Sexual and relationship health. Sexually active students of any age are at risk for acquiring an STD, becoming unintentionally pregnant, or becoming involved in sexual assault, especially acquaintance or date rape. Sexual activity to relieve academic stress, increase self-esteem, gain peer acceptance, or relieve loneliness can be mentally and spiritually damaging. Married students may find that the time and energy demands of college work create stress in their marital relationships.

Accidents and injuries. Many students commute to school, often rushing to and from work and home, and hence are at risk for automobile accidents. Alcohol-using students are at risk for auto and other kinds of accidents. Athletically active students are at risk for sports injuries.

Health issues, particularly stress and anxiety, are common impediments to academic performance (**Table 1.6**). Academic overload, tests, competition, career issues, relationship and family problems, and inadequate finances can create feelings of insecurity, anxiety, inferiority, and depression. Students can be lonely and have difficulty adjusting to campus life. Stress can impair sleep and also increase the risk for substance abuse.

TABLE 1.6 | **Health Impediments to College Student Academic Performance**

Health Issue	Percentage Reporting
Stress	42
Sleep difficulties	25
Anxiety	31
Cold, flu, sore throat	24
Depression	25
Upper respiratory infection	11
Alcohol use	4

Health Issue	Percentage Reporting
Poor health or death of someone close	14
Finances	14
Procrastination	47
Intimate Relationship	12

Data from Undergraduate Student Reference Group, Data Report, Spring 2020. American College Health Association Association, 2020.

https://www.acha.org/documents/ncha/NCHA-III_SPRING-2020_UNDERGRADUATE_REFERENCE_GROUP_DATA_REPORT_updated.pdf

How to Be Healthy

Considerable research has identified personal behaviors that contribute to health and longevity. These include the following:

1. Not smoking cigarettes. If you now smoke, quit. If you do not smoke, *never* start.
2. Quiet your mind (“destress”) with meditation, prayer, exercise, yoga, dance, or a creative endeavor.
3. Engage in regular physical activity (20 minutes per day; 3–4 days a week).
4. Interact regularly with people whose welfare you care about and who care about yours.
5. Get sufficient sleep (for most adults about 7–8 hours per night).
6. Eat a complete or near-vegetarian diet (e.g., Mediterranean Diet).
7. Consume no more than 10% of daily calories from saturated fat.
8. Limit snacking on junk foods that contain saturated fat, sugar, and salt.
9. Drink no more than one (women) or two (men) alcoholic drinks per day
10. Maintain a healthy body weight.

Surely, almost everyone wants to be healthy and well. Yet many people develop habits of thought and behavior that make them less well rather than more. Perhaps they are unaware of the ways in which some of their current life habits contribute to poor health. Or perhaps they know that changing certain health habits would be beneficial but they do not know how to make those changes.

It is said that knowledge is power, but with regard to living healthfully, that isn’t always the case. Almost everyone knows that smoking cigarettes, driving after drinking alcohol, and eating junk food are unhealthy, but many people do those things anyway. Simply knowing what to do is no guarantee that a person will do it.

If you find yourself in a hole, stop digging.

—**Will Rogers**, American comedian, actor, and writer

One must act. Living healthfully requires action based on accurate knowledge. Action has the components of setting goals, developing strategies for attaining goals including managing obstacles and expectations of whether you will be successful (called *outcome expectancies*).

Goals

A goal can be something you want or something you want to prevent or avoid. There are short-term goals (“I want to get a good night’s sleep”) and long-term goals (“I want to get my degree”). Goals can be clearly defined (“I’m going to study this Friday night instead of partying”) or fuzzy (“I want to do better at school”).

Goals reflect a person’s or a culture’s values, which are beliefs about what is important. Two values that affect health are valuing oneself (**self-esteem**) and valuing the physical and social environments in which one lives. When you value yourself, you are more likely to engage in healthful behaviors and have a high degree of psychological well-being. When you value your physical and social environments, you are more likely to contribute to making them clean, healthy, and supportive in helping others to attain their goals.

Strategies for Action

Strategies involve generating a variety of possible paths (brainstorming) and evaluating the ones with the greatest likelihood for success. Knowledge sought from others should be evaluated critically to be sure it is authoritative and authentic and not solely for the other’s financial gain. Besides planning, people assess whether they have the resources and ability to carry out the actions to accomplish their goals.

Expectations for Success

People pursue goals with expectations about the outcomes of their efforts. **Optimism**—imagining a high probability of attaining a goal—motivates, whereas **pessimism**—imagining a low probability of attaining a goal—stifles. Optimism is associated with perceiving negative events as specific, temporary obstacles to be overcome, whereas pessimism is associated with explaining negative events as self-caused (it's my fault), stable (it will last forever), and global (it's going to ruin everything).

Optimism also is associated with the tendency to perceive oneself as being able to move toward a desired goal or away from an undesirable goal. Optimism is associated with inner self-talk that is encouraging and hopeful (“I’ll find a way to solve this problem”). On the other hand, the self-talk associated with pessimism is anxious (“I’m not sure what to do”; “I’m not sure it will work out”) and self-critical (“I’m inept”).

One reason people resist making healthy lifestyle changes is that an unhealthy attitude or behavior is rewarding in some way, even if it is harmful in some other way (e.g., smoking cigarettes to relieve stress). To change a health behavior, a person must believe that the benefits of change outweigh the costs and that she or he is capable of making the desired change. Rituals such as New Year’s resolutions and slogans such as “Just Do It” offer unrealistic models of how habits are changed. Desire and willpower alone are insufficient; research, planning, patience, taking a step at a time, and enlisting social support are required as well. Following are three models that describe the process of health behavior change.

The Health Belief Model

The **Health Belief Model** has the following key aspects:

- **Perceived susceptibility.** Individuals vary widely in their perception of susceptibility to a disease or adverse health condition. Some deny the possibility of contracting an adverse condition. Others admit to a statistical possibility of disease

susceptibility. And still others believe there is real danger that they will experience an adverse condition or contract a given disease.

- **Perceived seriousness.** This refers to the beliefs a person holds about the effects of a given disease or condition on his or her life—for instance, pain and discomfort, loss of work time, financial burdens, difficulties with family, problems with relationships, and susceptibility to future conditions. It is important to include these emotional and financial burdens when considering the seriousness of a disease or condition.
- **Perceived benefits of taking action.** The action a person chooses will be influenced by his or her beliefs regarding the benefits of the action, particularly if the benefits outweigh the perceived costs.
- **Barriers to taking action.** Barriers such as inconvenience, cost, unpleasantness, pain, or upset may lead a person away from taking the desired action.
- **Cues to action.** Evaluation of benefits minus barriers provides the path of action. However, “cues to action”—either internal or external—may be required for the desired behavior to occur. An internal cue can be a sign, symptom, or feeling interpreted by someone as a health issue that needs attention. An external cue is a suggestion from someone that it’s a good idea to participate in some health-related activity.

The Transtheoretical Model

The **Transtheoretical Model** proposes that a health behavior change occurs through the following stages:

- **Precontemplation.** The person is not considering changing a particular behavior in the foreseeable future. Many individuals in this stage are unaware or barely aware of their vulnerability. Information is important during this stage.
- **Contemplation.** The person becomes aware that change is desirable but has not committed to act. The person often focuses on why it would be difficult to change. Information on options on how to change the behavior can be helpful during this stage.
- **Preparation.** The person desires change and commits to making that change in the near future, usually within the next 30 days. Instead of thinking why he or she can't take action, the focus is on what can be done to begin. The person creates a realistic plan for making a change, including overcoming obstacles. This stage may include announcing the change to friends and family, researching how to make the change, making a calendar, or setting up a diary or journal to record progress and obstacles to progress.
- **Action.** The person implements the plan. The old behavior and the environmental situations that reinforced it are stopped and new behaviors and environmental supports are adopted. Obstacles are expected and noted, and strategies for overcoming them are implemented. Progress through this stage may take 6 months or more.
- **Maintenance.** The person strengthens the change, recognizing that lapses and even temptations to give up will occur. "Ebb and flow" is to be expected and should not be seen as failure. The

person can remind himself or herself of the many benefits of and gains from the behavior change to help combat relapse.

- **Termination.** The person is not tempted to return to the previous behavior.

The Theory of Reasoned Action/Theory of Planned Behavior

The **Theory of Reasoned Action** or **Theory of Planned Behavior** proposes that changing a health behavior begins with an intention to adopt a new behavior (e.g., stop smoking). The intention is a combination of a positive attitude about performing the behavior (e.g., “Not smoking is good”) and the person’s thoughts about how others will respond to the new behavior (e.g., “My girlfriend will be happy if I stop”). Furthermore, change is affected by the person’s perceptions of how much control he or she has over bringing about the desired change (e.g., “I can do this if I get some support”).

Health Starts with Each of Us

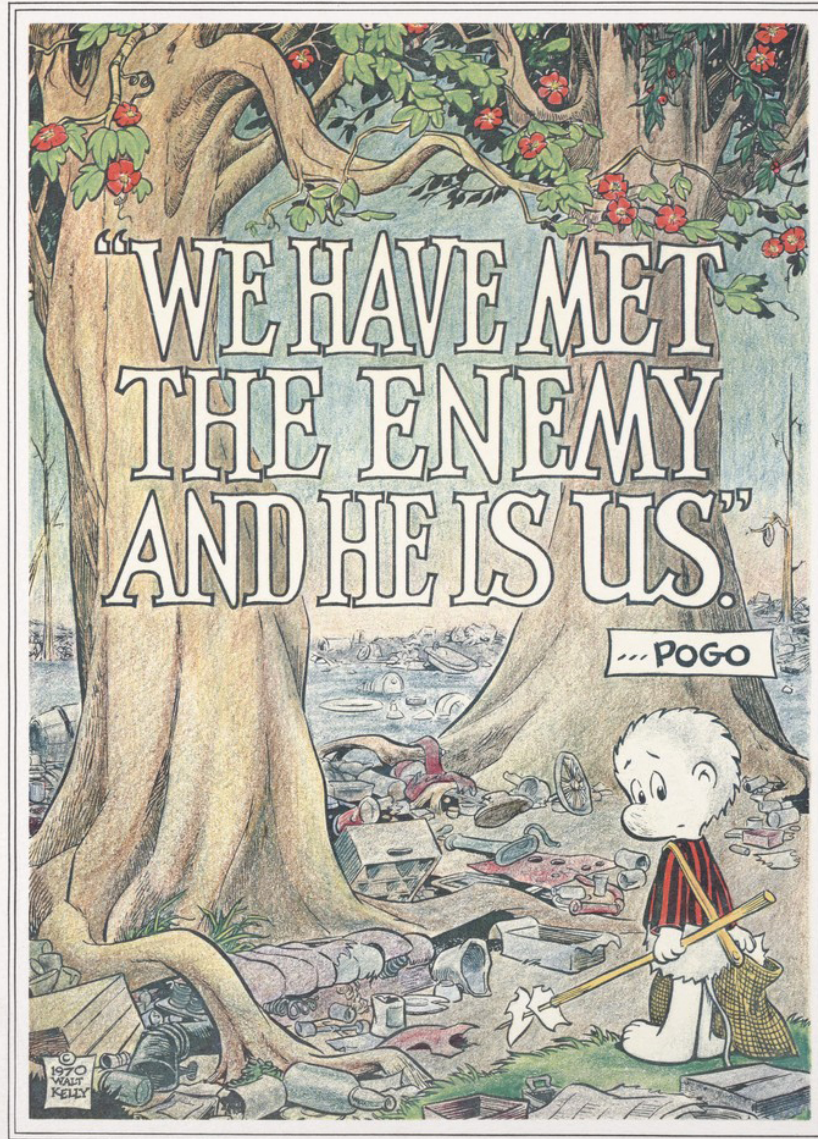
It is clear from many kinds of health research that each one of us needs to do more to maintain and improve our health. When one is young, thinking about health is the last thing one is interested in doing. We (the authors) certainly did not worry about our health when we were teenagers or even in college. Moreover, 50 years ago, eating as much meat as you could afford, smoking cigarettes, and getting drunk were generally accepted behaviors. When you are 20 years old, thinking about living to 60 or 70 years of age is unimaginable. Unlike 50 years ago, we now know that protecting health is something that has to begin while you are young. Making lifestyle changes when you already are old (and presumably wiser) is mostly too late.

Health is similar to retirement: It is something you have to plan for and pay attention to while you are young. For example, putting away just a few dollars every month adds up to an enormous sum in 50 years, but most of us never think about doing it. The same holds true for health. Making small, positive changes in your health and lifestyle now will pay enormous dividends in the future.

After a resounding victory over the British Navy in the Battle of Lake Erie in the War of 1812, U.S. Naval Commander Oliver Hazzard Perry proclaimed, "We have met the enemy and they are ours." To commemorate Earth Day 1971, American cartoonist Walt Kelly enlisted his creation, "Pogo the Opossum," to proclaim, "We have met the enemy and he is us!"

Since the latter part of the 20th century, Earth's 7.6 billion human inhabitants have increasingly become challenged by a set of threats to their health and well-being. The gravest is global climate change resulting from a rapid increase of carbon dioxide in Earth's atmosphere from the burning of fossil fuels for energy. Today, no one could blame Pogo (see [Figure 1.6](#)) were he to reissue his 1971 proclamation with regard to climate change, as well as several global

viral pandemics such as the recent SARS-CoV-2 (COVID-19), epidemics of heart disease, type 2 diabetes, sexually transmitted infections, depression, and anxiety, and the ever-present threat of nuclear conflict.



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Figure 1.6 Pogo the Opossum.

Reproduced from Print 1980. The Walt Kelly Estate. Published by Swamp Yankee Studio.
Box 2311, Bridgeport. CT 06608.

As Pogo might say, “Everyone’s health is up to us!” Each of us is responsible for our overall health and well-being. We determine the ways our thoughts, feelings, and behaviors contribute to or lessen our health; whether our dietary habits are healthy; how much we care for rather than harm ourselves; and contributing to developing and maintaining health-promoting economic, social, and physical environments.

Critical Thinking About Health

1. As pointed out in this chapter, the major health issues of college students are sexual health, mental health, substance abuse, weight, accidents and injuries, and health care. Discuss which of these issues is of most concern to you personally. Explain your reasons and worries. How can you deal with your concerns in a way that will improve your health?
2. Describe one lifestyle behavior you routinely engage in that you regard as harmful to your health (not exercising regularly, for example). Discuss your reasons for continuing to engage in this unhealthy behavior. Consider what you might do to change this behavior and list the steps you would take to accomplish the healthy change. Do you believe that you can make the healthy change?
3. Imagine that you are the surgeon general of the United States, who formulates national health policy. (One former surgeon general, the late C. Everett Koop, formulated the crusade against tobacco smoking a generation ago.) Describe what you believe is the primary health problem in the United States today. Justify your choice with as many facts as you can. Describe the steps you believe should be taken by government, private companies, organizations, and individuals to eradicate this health problem.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

The word *health* can have many meanings. For some, being healthy simply means not being sick. For others, physical health and strength matter most, and emotional and mental health are of lesser concern. For others, emotional and spiritual well-being are paramount. If you are concerned with *all* aspects of your health, then you think of health holistically. A holistic approach to health means that you strive for physical, mental, emotional, and spiritual well-being. You also try to live in harmony with your environment and with friends, family, and society.

Many people born since 2000 will live to 100 years of age or more. Adopting healthy lifestyles while young will help ensure a healthy old age. Most people are born healthy but become unwell because of unhealthy lifestyles. Chronic diseases such as heart disease, cancer, diabetes, and others are primarily the result of unhealthy lifestyle choices such as smoking tobacco, drinking alcohol to excess, consuming low-quality foods, and a lack of regular physical exercise. Maintaining a healthy body and mind will help you recover from occasional sickness and injuries that are inevitable parts of life.

The path to physical, mental, emotional, and spiritual health is to set health goals for yourself beginning now. Adopt healthy habits that feel right for you. Perhaps the most important word to remember in striving for a healthy lifestyle is *moderation*. Eat when hungry and do not eat more once you are full. Refrain from mindless snacking when bored or while engaged in sedentary recreational activities (watching TV, playing video games, using social media). Make movement a part of your daily life. Walk more, use stairs instead of elevators, ride a bike, dance, or do yoga. And be sure to take time to quiet your mind, especially when you are angry, stressed, or upset.

Health does not come from outside ourselves. The key to a healthy life has always been self-responsibility. Doctors, hospitals,

drugs, and government rules cannot make you healthy. They can help prevent illness and injuries and often restore body and brain to a semblance of normal functioning. But you are always the one responsible for your moment-to-moment, day-to-day health.

HIGHLIGHTS

- Health is not only the absence of disease but also living in harmony with oneself, friends and relatives, and social and physical environments.
- The World Health Organization defines health as “a state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity.”
- Health means being responsible for preventing personal illness and injuries as well as knowing when to seek medical help.
- The dimensions of wellness are emotional, intellectual, spiritual, occupational, social, and physical.
- Determinants of health and wellness consist of personal biology, economic and social circumstances, environmental, and individual factors that affect individuals and communities.
- Many illnesses (e.g., diabetes, heart disease, cancer) are *lifestyle diseases*—that is, primarily attributable to unhealthy living habits. Taking responsibility for your health while you are young is the best way to reduce the risk of chronic disease later in life.
- Unhealthy lifestyles and behaviors are responsible for half of all deaths in the United States each year.

- The health status of Americans is lower than nearly all of its peer-income countries, principally because of high costs and the absence of rules regarding access to medical and health care.
- *Healthy People 2030* is a set of national health objectives characterized by enhancing the quality of life, reducing the incidence of preventable diseases and premature deaths, and reducing disparity in health status among different demographic groups.
- Health issues facing North American college students include stress, anxiety, depression, overweight, lack of health care, substance abuse, and sexual and relationship health.
- Changing health behaviors requires knowledge, planning, and social support.

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KEY TERMS

well-being:

qualities of life that include positive emotions (e.g., happiness, contentment) and life satisfaction

medical model:

interprets health in terms of the absence of disease and disability

chi:

universal energy that must be distributed harmoniously throughout the mind–body to attain and maintain health; also known as *qi*

wellness model:

encompasses the physiological, mental, emotional, social, spiritual, and environmental aspects of health

physical wellness:

maintaining a healthy body by eating right, exercising regularly, avoiding harmful habits, and making informed, responsible decisions about your health

emotional wellness:

understanding emotions and knowing how to cope with problems that arise in everyday life and how to manage stress

intellectual wellness:

having a mind open to new ideas and concepts

social wellness:

ability to perform social roles effectively, comfortably, and without harming others

spiritual wellness:

state of balance and harmony with yourself and others

occupational wellness:

enjoyment of what you are doing to earn a living and contribute to society

environmental wellness:

living in an environment characterized by clean air, water, and land that also supports basic human needs and is free of interpersonal violence and the threat of climate change

financial wellness:

attaining and maintaining resources to meet physical, psychological, and social needs by planning for the future, preparing for unforeseen financial difficulties, and being aware of others' financial values, needs and circumstances

determinants of health and wellness:

consist of personal, social, economic, and environmental factors that affect individual, community, and world health

lifestyle diseases:

negative health conditions from personal behaviors such as cigarette smoking, poor diet, and a sedentary lifestyle

chronic disease:

a disease that persists for years or even a lifetime

type 1 (insulin-dependent) diabetes:

when the pancreas is diseased and unable to manufacture the hormone insulin to regulate the level of sugar in the blood

type 2 (non-insulin-dependent) diabetes:

caused by too much fat in the blood (generally from being overweight), resulting in the body becoming resistant to the actions of insulin

health status:

an individual's state of health and wellness, accounting for the presence of disease, disability, and the individual's self-rated assessments of overall physical, mental, and social health

incidence:

the number of new cases of a particular disease

prevalence:

the number of people within a population with a particular disease

health disparities:

differences in health status based on race, income, educational attainment, and access to healthy food, healthy environments, and quality medical care

self-esteem:

the judgment one places on one's self-worth

optimism:

the thought process of imagining a high probability of attaining a goal

pessimism:

the thought process of imagining a low probability of attaining a goal

Health Belief Model:

health behavior change is a function of a person's perceived risks for behaving as usual and benefits from change

Transtheoretical Model:

health behavior change starts with considering making a change followed by planning, implementing the plan, and overcoming obstacles
theory of reasoned action: change begins with an intention to adopt a new behavior and doing so is beneficial

Theory of Reasoned Action or Theory of Planned Behavior:

proposal that changing a health behavior begins with an intention to adopt a new behavior



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CHAPTER 2

Mind–Body Harmony



Health Tips

Make Up Your Own Mantra for Changing Behaviors

Image Visualization Reduces Stress



Managing Stress

Biofeedback

Focusing Attention for Mind–Body Harmony

Relaxation with Music



Wellness Guide

Using Your Mind to Heal Your Body

Self-Care: Mindfulness Meditation for Lifelong Well-Being

Positive Thinking Has the Power to Improve Health

LEARNING OBJECTIVES

1. Describe three ways the mind and body communicate biologically.
2. Define psychosomatic illness.
3. Describe and give examples of the placebo effect and the nocebo effect.
4. Describe how faith, religion, and spirituality affect health.
5. Explain hypnotherapy.
6. Describe meditation and image visualization.

The mind is central to health and well-being. By *mind* is meant the brain processes that create thoughts, beliefs, attitudes, emotions, and the nature and quality of interactions with the social and physical environments. That the mind is anatomically and functionally connected to the entire body allows thoughts, beliefs, and feelings to affect the body's chemistry and physiology, and vice versa. This means that, with intention and attentional focus, to a large degree people can use their powers of mind to influence their health and well-being.

Considerable research shows that positive thoughts such as trust and love, and positive emotions such as happiness, contentment, and joy, can lead to states of mind–body harmony that motivate living healthfully, aid healing and recovery from illness and injury, and increase longevity (Moskowitz, Addington, & Cheung, 2019). Fear, anxiety, stress, and depression contribute to mind–body disharmony, which increases the risks for a variety of illnesses, impedes healing, and fosters a sense that life is difficult and unpleasant. When your thoughts, feelings, and behaviors are in harmony within yourself and you live harmoniously within your social and physical environments, you are more likely to feel good and be in measurable good health than if you are chronically angry, frightened, stressed, depressed, and at odds with your surroundings (McEwen & Akil, 2020).

Mechanisms of Mind–Body Communication

The mind and brain and body form a unified whole. No mind exists without a body and no body exists without a mind. The mind–body seeks balance through alertness and adaptive responsiveness to changes in the body or the external environment. When adaptations to change proceed smoothly, we feel in sync with ourselves, relaxed, confident, happy. When change is overly disruptive, we generally experience pain, fear, and anxiety to signal something is amiss.

To adjust to change, the mind and body communicate with each other. A simple example: On a walk in the woods, the hearing apparatus of the ears registers a sound. That information is transmitted to the brain, which interprets the sound as that of a hissing snake, even if no snake is visible. Based on prior learning, the brain interprets this situation as dangerous and activates the nervous system's fear networks, which in turn activate the brain's and body's movement systems to orchestrate a rapid escape.

The brain communicates with the body by means of the nervous, endocrine (hormone), and immune systems (see below). Sensory nerves register changes inside and outside of the body, and that information is transmitted to the brain. The brain assesses the nature of changes, often by comparing them to prior experiences stored in memory, and that information is transmitted to parts of the brain responsible for the body responding in the most healthful way.

The Autonomic Nervous System

A major pathway by which the mind and body communicate is through the **autonomic nervous system (ANS)**, a group of nerves that regulate many of the body's physiological processes, such as heart rate, blood pressure, breathing, and the functioning of the gastrointestinal, urinary, and reproductive systems (**Figure 2.1**). Centers in the brain receive information about the state of the body or environment (or both) and activate the nerve fibers of the ANS in

response to maintain appropriate physiological balance. For example, when you exercise, the ANS stimulates the heart's pacemaker cells to increase your heart rate, thus increasing the amount of blood pumped to moving muscles.

Sympathetic

Dilates pupils

Inhibits salivation

Dilates bronchi
(lungs)

Stimulates
heartbeat

Stimulates
adrenal gland

Inhibits digestion
(stomach, pancreas,
liver, spleen)

Dilates bladder

Parasympathetic

Constricts pupils

Stimulates salivation

Constricts bronchi
(lungs)

Slows heartbeat

Inhibits adrenal
gland

Stimulates digestion
(stomach, pancreas,
liver, spleen)

Contracts bladder

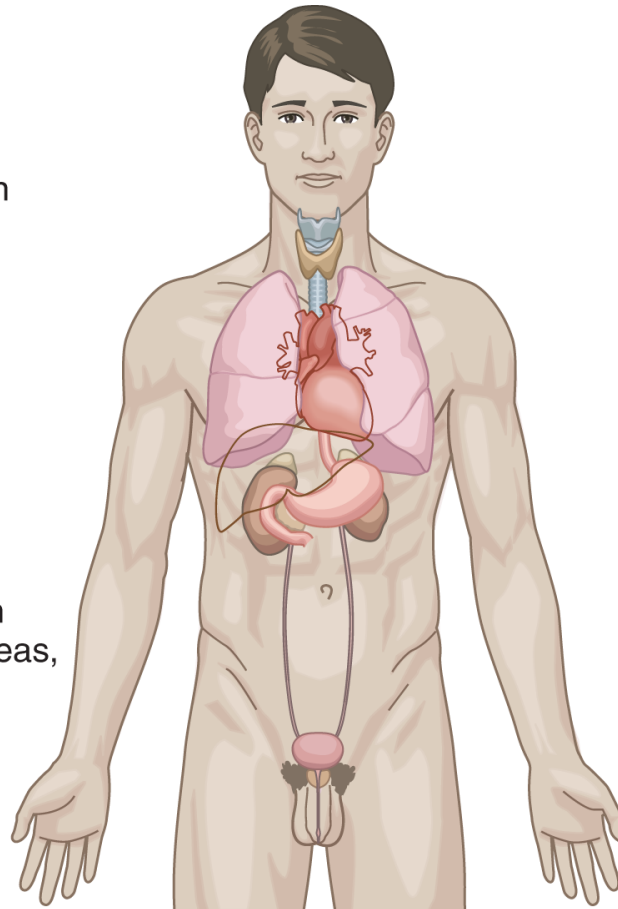


Figure 2.1 Functions Controlled by the Autonomic Nervous System. The autonomic nervous system has two parts or divisions—the sympathetic division and the parasympathetic division. These regulate functions that normally are not under conscious control such as breathing, digestion, and heart rate.

Description

The autonomic nervous system derives its name from the fact that its activities normally operate without conscious control. Thus, when jogging, you do not think about how fast your heart should beat or whether you should sweat to cool yourself. Even though the ANS functions without conscious control, the signals it sends to the body

can be affected by thoughts and feelings. For example, nearly all students are familiar with the nervous stomach and sweaty palms that accompany the stress of taking an important exam. Realizing that it is possible to do poorly on an exam (a thought) leads to anxiety (an emotion), which activates the ANS to produce test-anxiety symptoms. Fear has an immediate effect on breathing and heart rate, and stress can constrict blood vessels, causing headaches or high blood pressure.

Many students live fast-paced, hectic lives that are full of time pressures and stress. Besides doing school assignments, many students work at jobs, and nearly all try to maintain harmonious social relationships with family and friends, which take time and attention. Moreover, the modern environment is filled with smartphones, computers, the Internet, TV, video games, and other stimuli that compete for attention. Trying to accommodate all of life's demands produces near continuous physiologic arousal mediated by the sympathetic nerves of the ANS, causing anxiety, sleep disturbances, muscle tension, gastrointestinal symptoms, and an increased risk for cardiovascular disease among other things.

ANS-mediated arousal can be counteracted by putting 20 to 30 minutes or more of quiet time into your life each day. (If you must, schedule it in your day planner.) You can employ any of a number of techniques designed to lessen ANS arousal and create a sense of mind–body harmony. Or you can find a quiet spot in a park or a room where you can comfortably and silently reflect on and be grateful for the good things in your life, and let go for a time of the problems of the world and task you need to accomplish.



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Hormones

Besides the autonomic nervous system, the mind can affect physiology via the endocrine (hormone) system. **Hormones** are chemicals produced by special organs and tissues in the body. There are about 20 different hormones. Each hormone regulates specific biological functions (**Figure 2.2**). Hormones notify the body of changes outside and inside the body that must be responded to in order to maintain health.

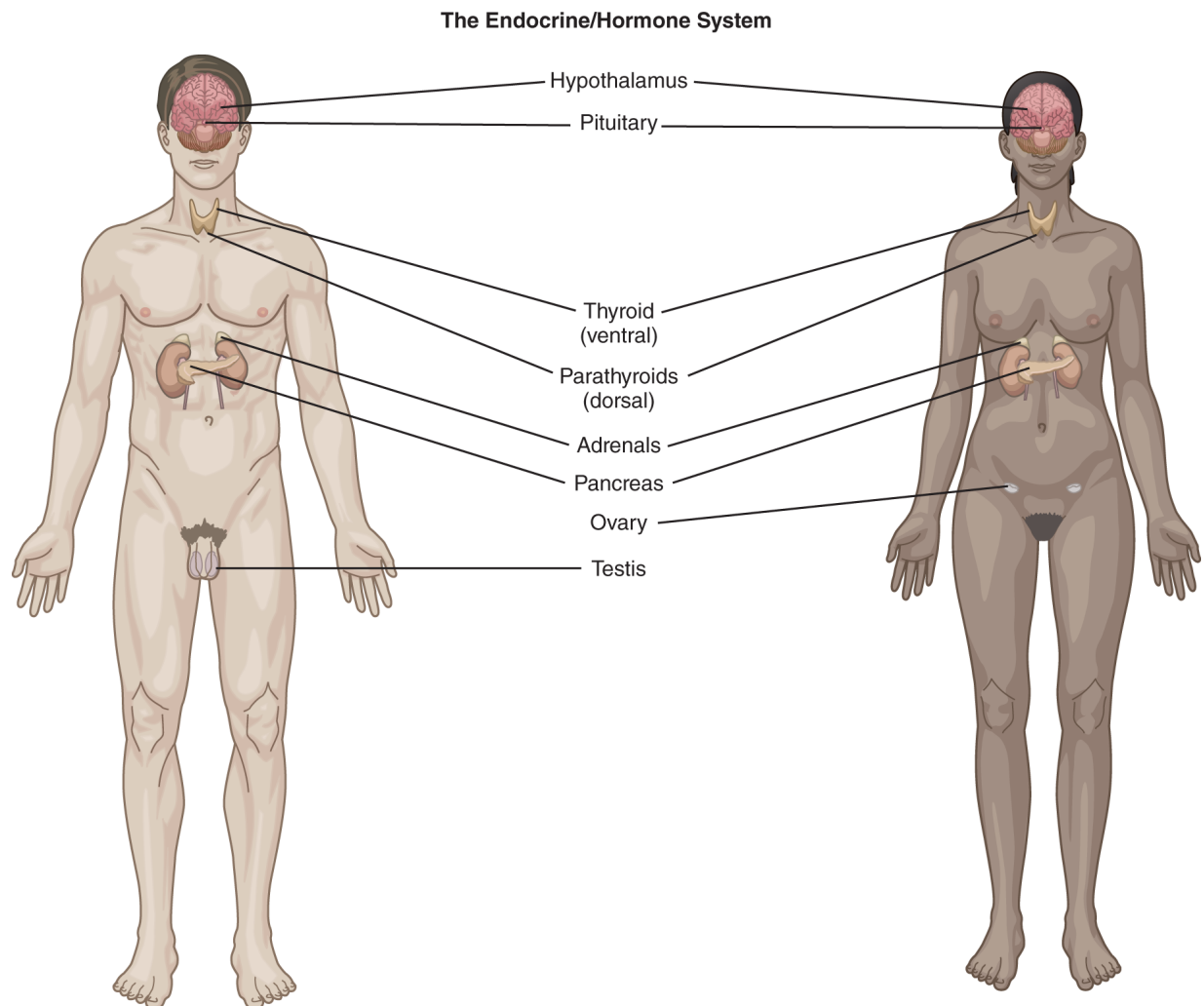


Figure 2.2 Where Hormones Are Released. Hormones are released from different glands and organs throughout the body, including the brain. The synthesis and release of these hormones are regulated by the mind and autonomic nervous system. Hormones are chemical messengers that tell organs in the body how to respond to stimuli.

Description

Many hormones respond to changes in thoughts and feelings. For example, if the mind interprets a situation as threatening or frightening, regardless of whether the danger is real or imagined, centers in the brain responsible for emotions signal other parts of the brain and body to release hormones such as adrenaline and cortisol into the bloodstream. These hormones circulate to several of the body's organs and tissues to make the mind and body alert and ready to deal with the danger. The brain hormone oxytocin stimulates feelings of closeness, affection, and emotional warmth.

Hormones manufactured in the brain can affect other areas of the brain; however, most hormones that originate in the brain are released into the circulatory system and travel throughout the body. Certain brain hormones have been associated with increases or decreases in particular feelings and behaviors ([Table 2.1](#)). Thus, the environment, the brain (mind), and hormones (chemical messengers) are intricately interconnected and ultimately can affect health.

TABLE 2.1 | Hormone Levels Can Affect Moods, Thoughts, Feelings, and Behaviors

Hormone	Effects of High Levels
Cortisol	High blood levels of cortisol increase stress and alertness, decrease sensitivity to pain, impair memory processing, and increase depression.
Dopamine	High blood levels of dopamine increase pleasure and motivation and decrease sadness.

Hormone	Effects of High Levels
Oxytocin	High blood levels of oxytocin increase trust and feelings of attachment and decrease fear.
Vasopressin	High blood levels of vasopressin increase sexual arousal and attention but decrease anxiety.
Serotonin	High blood levels of serotonin increase aggression and obsessive thoughts.

The Immune System

Besides the ANS and endocrine system, the mind and body communicate via the **immune system**. The immune system is responsible for combating infections and ridding the body of foreign organisms and toxic substances. Immune system cells, tissues, and organs are located throughout the body. The immune system can be influenced by the mind via the nervous and endocrine systems. Nerves of the sympathetic nervous system connect to certain immune tissues such as bone marrow, lymph nodes, and spleen. Many immune cells respond to the presence of the hormone cortisol as part of the stress response. Moreover, the immune system releases special chemicals called *cytokines* that can affect the nervous and endocrine systems.

Many studies have demonstrated that the mind can affect the workings of the immune system. It is well known that stress and negative mood states can weaken the immune system and that methods to reduce stress such as mindfulness meditation and t'ai chi chuan strengthen immune response (Antoni, 2012). Positive emotions such as feeling calm and peaceful, happy, and optimistic about life can enhance immune function (Pressman & Black, 2012).

The Placebo Effect

A stark example of the mind's effect on wellness is the **placebo effect** (from the Latin "I shall please"), which refers to the lessening of symptoms or curing of a disease by a person's belief in the curative power of an inert medicine (called a *placebo* or *sugar pill*) or belief in the healing power of a person, special words, or objects. Although a placebo is often thought to be a fake medicine that tricks an unwell person into feeling better, in actuality a placebo produces identifiable biological changes. Healing is not imagined.



Using Your Mind to Heal Your Body

Have you ever cut or burned your hand? Perhaps you were cutting food and the knife slipped, or perhaps you reached for a pan on the stove, forgetting that the handle was hot. The usual response to such accidents is anger at being careless or forgetful and anger at the sudden pain. We jump around and get upset, which generally exacerbates the injury and delays healing. A much better response to minor injuries that do not require immediate medical attention is the following.

In case of a cut, place a clean cloth over the wound and press gently to help stop the bleeding. Then sit or lie down. Close your eyes and allow yourself to become mentally and physically quiet. In your mind, visualize the injured part and see it as it was just before the accident. Then imagine the process of healing. See the skin coming back together. Feel the pain recede. Notice diminished bleeding. Continue doing this for 5 minutes or longer until you feel calm. If the accident caused a burn, place an ice bag or cool wet cloth over the wound. Then lie down and visualize the skin becoming cooler and looking like the normal skin around the burn.

By immediately calming the mind after an injury, inflammation and other harmful physiological reactions in the area are reduced. Healing processes begin immediately when you send positive, calming thoughts and images to the injured area. Continue to visualize healing in the injured area.

Placebos work because the expectation of effectiveness brings about real physiological changes that lead to healing. For example, researchers (Wager et al., 2004) exposed volunteers to harmless but occasionally painful electric shocks or heat. When the volunteers applied to their arms what they believed to be an antipain cream, which was really an inert substance—a placebo—they rated the pain as less intense. The placebo also lessened activity in brain regions associated with experiencing pain. The *expectation* of pain relief—a product of the mind—produced biological pain relief, a product of the body. Many variations of this experiment have further shown that the expectation of pain relief is associated with the manufacture and release of the brain's own pain-relieving chemicals (endorphins, enkephalins, and cannabinoids).

The placebo effect occurs in almost every medical treatment (Wager & Atlas, 2015), in many instances to a remarkable degree

(Figure 2.3). The placebo effect is so common and powerful that the U.S. Food and Drug Administration (FDA) requires that a new drug undergo *double-blind, placebo-controlled trials* for safety and effectiveness. This means comparing one group of volunteers' responses to a new drug with a different, matched group's responses to a placebo (the control group). To minimize bias, people in the test group and people in the placebo group do not know which substance they are receiving—that is, they are “blind.” Furthermore, none of the scientists administering the test drug or the placebo knows what any of the volunteers are receiving—in other words, they also are “blind.” Only the project manager knows who received what. The efficacy and safety of the test drug is determined by its performance compared to the placebo.

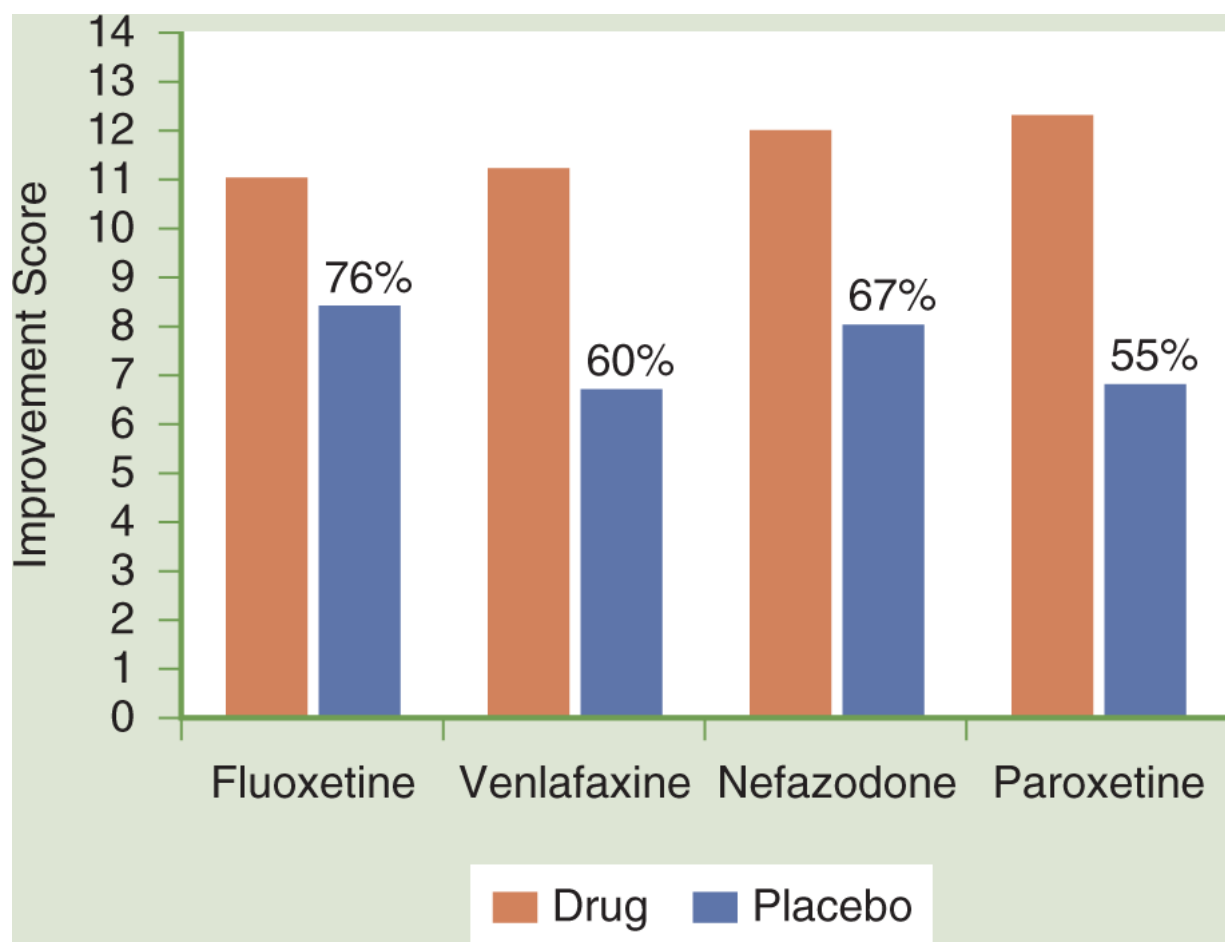


Figure 2.3 Comparison of Four Antidepressant Medications and Placebo in Improvement of Symptoms of Mild and Moderate Depression. The bars in the graph indicate the degree of improvement in symptoms of depression as determined by the Hamilton Depression Rating Scale (<http://www.psy-world.com/hdrs.htm>). In each instance, the placebo produces considerable improvement.

Data from Kirsch, I., et al. (2008). Initial severity and antidepressant benefits: A meta-analysis of data submitted to the Food and Drug Administration. *PLoS Medicine*, 5, e45. <http://www.plosmedicine.org/article/info:doi/10.1371/journal.pmed.0050045>

Description

The placebo effect occurs in the treatment of many diseases, including ulcers, irritable bowel syndrome, colitis, chronic pain, headache, hay fever, asthma, depression, warts, and high blood pressure. The number of patients responding to placebos for almost any disease or symptom ranges from 30% to 70%; most placebo-controlled drug studies find that about half of all patients respond to placebos. This remarkable finding means that you have a 50–50 chance of getting better simply by believing something will cure your ailment.

Depression is a condition in which the placebo effect can account for as much as 75% of any relief experienced. To determine how the placebo effect could be operating to relieve depression, researchers used a *positron emission tomography* (PET) scan to visualize the activity of different regions of the brain when depressed individuals received antidepressant medication or placebo (Mayberg et al., 2002). The results showed that the pattern of brain activity of patients receiving placebo was almost the same as those receiving antidepressant medications. Apparently, the expectation that their symptoms would improve caused biological changes in the brain that contributed to relief of depression (Kirsch et al., 2008). Figure 2.3 shows comparisons of the effectiveness of four antidepressant medications and placebos to reduce symptoms of mild to moderate depression. Note that in each instance the placebo is almost as effective as the medication. About 60% of patients respond to the placebo as do those receiving the drug. Because one major

characteristic of depression is feeling hopeless and that things cannot improve, these results suggest that believing that one is receiving an antidepressant medication triggers a sense of hope, which reduces symptoms of depression. Antidepressant drugs and placebos produce similar alterations in brain chemistry, principally elevations in the neurotransmitters serotonin and norepinephrine.

Why, if placebos are so effective in healing, are they not used more by physicians in treating patients? One reason is an ethical dilemma for physicians: A placebo might work for one patient but not for another. Although the same could be true for a prescribed drug, the physician is protected legally by prescribing a drug that has been clinically tested and approved by the FDA. However, no legal protection exists for a physician prescribing a placebo if the patient decides to sue, claiming that the treatment did not meet accepted medical standards.

Who knows what might work as a placebo? Perhaps consuming a couple of M&Ms twice a day can cure pain and many other symptoms. Often the safest and best path to relief of suffering is to engage the power of the mind.

The placebo effect can also act in reverse and cause pain, distress, or illness. This is called the **nocebo effect** (from the Latin “I shall harm”). Because words can produce a nocebo effect, it’s wise to consult health practitioners whom you trust and who use positive, constructive healing suggestions and encourage becoming involved in self-healing practices. No one needs to hear negative suggestions such as “You’ll probably have to take these pills for the rest of your life,” or “I doubt that you’ll be able to move around much after an accident like that.” When being prescribed a medication, it’s helpful for the health practitioner to say something like, “I’m optimistic that this medication is going to do the trick” instead of “This medication works OK, but not for everyone.”

In the presence of a physician, many individuals become psychologically open to suggestions, both positive and negative, because their minds are intently focused on what the practitioner is saying. Such a focused state of mind is similar to that obtained in meditation or hypnosis. It is more helpful for people to be alert and

critical when discussing health concerns or results from a medical test. This is not always easy to do, especially when the information being conveyed may cause distress or fear. It is probably wise to take some time to settle oneself before accepting totally what a health practitioner has said or *what one imagines* she or he has said.

A tragic but dramatic example of a nocebo effect involved a patient who died apparently from reading a single word (Hewlett, 1994). This person had a history of chronic lymphocytic leukemia, a form of blood cancer that usually is easily controlled with drugs. The patient had been well for more than 3 years with only intermittent need for medication. However, he had never actually been informed of the original diagnosis of his condition.

One day he was in his physician's office on a routine visit and happened to read the physician's notes, which were lying on the desk. He saw the word *leukemia* in his file. He missed his next scheduled office visit and shortly thereafter showed up in the hospital's emergency room. Within 3 weeks, he died in the hospital. No cause of death could be discovered at autopsy, and his leukemia was still in remission. The patient apparently believed that he had terminal cancer just from seeing the word *leukemia* in his medical records.

The Mind Can Create Illness or Wellness

That thoughts and feelings can alter physiological processes means that individuals have the power to influence their health for ill or for well-being. For thousands of years, belief in the healing powers of a deity or special person such as a king, priest, or shaman or ascribing healing powers to a potion or elixir have been employed to heal the sick by ridding the body demons and evil spirits. Today's patients have faith in the knowledge of their physicians and the medicines they prescribe just as people of ancient civilizations believed in their priests and herbs. Any improvement in a patient's condition is likely a combination of faith in the healer and the efficacy of the treatment.

Ancient Egyptian papyri show that the priest physicians of ancient Egypt relied on the belief of the people in the healing power of the gods. Priests would put patients into a trance in a temple and tell them that when they awakened, they would be healed. And often they were. Greek and Roman healers also used trance and sleeplike mental states to impart healing suggestions to people who believed that their healers had divine powers. King Pyrrhus of Epirus is reputed to have cured sick individuals solely by the touch of his big toe.

Faith. You can do little with it and nothing without it.

—Samuel Butler

The New Testament recounts many examples of the healing power of Jesus:

Is any sick among you? Let him call for the Elders of the church and let them pray over him, anointing him with oil in the name of

the Lord; and the prayer of faith shall save the sick.

—James 5:14–15

That evening they brought him many who were possessed with demons, and he cast out the spirits with a word, and healed all who were sick.

—Matthew 8:14

And he said to her, “Daughter, your faith has made you well; go in peace and be healed of your diseases.”

—Mark 5:34

A personal relationship with the transcendent or sacred, either through religion or other spiritual beliefs and practice, can provide a powerful and meaningful way to cope with life-changing and traumatic experiences such as disease, aging, and death. During the COVID-19 global pandemic, many patients and their families, and healthcare workers turned to religious or spiritual practices to provide a compassionate presence, allay fears, promote strategies for managing stress, promoting recovery and resilience, and supporting hopes and dreams for a better future (Roman et al., 2020).

Many people use prayer to help them cope with illness. People pray for their own health and the health of others; they pray individually and in prayer groups. People pray to God, a “guardian angel,” or a deceased loved one for support and personal strength to cope with illness. Because feelings of security and confidence are associated with religious experience, the social support offered by religious affiliation can enhanced immune function.

At times of serious illness or when death is a possibility, many individuals want their physicians to be aware of their spiritual or religious beliefs. On the other hand, for routine health matters most patients do not want their physicians to be directly involved in their health-related spiritual experiences. Most doctors believe that a patient’s spiritual outlook is important to handling health difficulties and that physicians should ask patients about spiritual and religious

issues, although few physicians believe that it is appropriate for health practitioners to recommend prayer and religious activities to patients.

The Mind Can Create Illness

Psychosomatic Illnesses

The power of the mind to cause illness is borne out by a long list of psychosomatic illnesses (**Figure 2.4**). These conditions are caused in large measure by mental states and attitudes such as persistent anxiety, depression, and stress that produce unhealthy physiological changes and induce self-destructive behaviors to cope with distress. That is why these illnesses are called **psychosomatic**, a term derived from the Greek (*psych*, mind; *soma*, body).

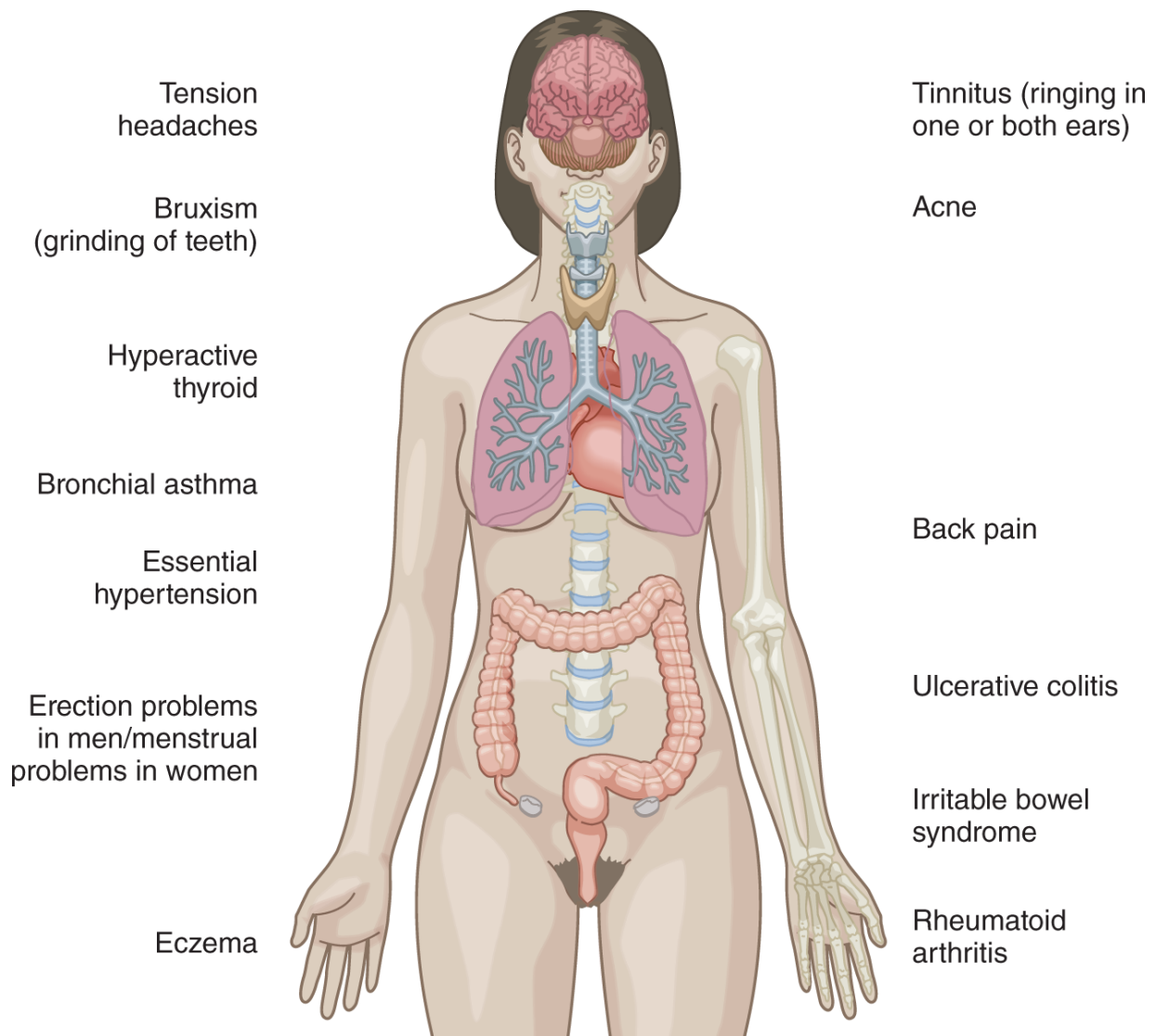


Figure 2.4 Psychosomatic Illnesses. Many diseases and disorders of the body are partly caused by thoughts and feelings.

Description

Many people believe that psychosomatic means imaginary, that “it’s all in the head.” This is not the case. The damage to the gastrointestinal tract in someone with stress-related bowel illness is just as real as the damage caused by an infection or injury. *Psychosomatic* means that thoughts and feelings are at the root of a physiological abnormalities that cause symptoms. For example, depression or anger may cause pain (especially low back pain), fatigue, nausea, diarrhea, and sexual problems.

A large percentage of visits to primary care physicians are estimated to be for psychosomatic symptoms. These symptoms are difficult and time-consuming for health practitioners to diagnose and treat, and they are expensive for the healthcare system. A common complaint is pain of long duration in several parts of the body that cannot be explained by any medical condition or injury. Many health practitioners tend not to treat psychosomatic illnesses; they offer medications to suppress symptoms rather than invest time addressing the underlying mental states that cause an illness. This occurs in part from their training, which focuses primarily on biological causes of illness, and in part by not having time to probe the lifestyle of a patient with a psychosomatic illness; also, the patient's health insurer is not likely to pay for the doctor to do so.

Having to live in harsh financial, family, social, or environmental circumstances can disrupt mind–body harmony to the degree of producing pain and sickness. Health can be restored with knowledge of how the mind and body interact and the application of methods that produce insight to the particular issue. Compassionate professional help and guidance are also highly beneficial.

The Mind Can Create Wellness

The power of the mind to create wellness is illustrated by studies that show that positive emotions are associated with healthful biological changes. For example, a group of English civil service workers were asked to rate their state of happiness several times during a typical workday while researchers measured their blood pressure, heart rate, and stress hormone (cortisol) levels. Those with the highest happiness ratings showed the lowest heart rate and stress hormone levels (there was no effect of happiness on blood pressure).

The role of humor in maintaining health has a long history. Plato advocated humor as a means to lighten the burdens of the soul and to improve one's health. From medieval court jesters to modern circus clowns, laughter has been used to help people forget their problems, restore mind–body harmony, and foster health and healing. In 1979, Norman Cousins, a well-known magazine editor,

described how he had cured himself of a rare untreatable disease (ankylosing spondylitis) by watching humorous movies for months until he had laughed himself well (Cousins, 1979). Scientific studies have confirmed that humor has a positive effect on the immune system by increasing levels of natural killer cells that help prevent infections (Bennett & Lengacher, 2009). Humor elevates pain thresholds by activating endorphins (hormones released in the brain) that affect pain responses. Humor reduces stress and anxiety in cancer patients, becoming a powerful adjunct to medicines in the healing process (Roaldsen, Sørli, & Lorem, 2015). Laughter is healthy because it causes the release of two “feel good” chemicals in the brain—endorphin and dopamine—and decreases the production of cortisol, a stress hormone.



Take a time out to meditate whenever you need to.

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Resilience

As you undoubtedly know from your own experience, life has its gains and losses, ups and downs, good days and bad days, sickness and health, joys and sorrows, and victories and defeats. A life totally free of adversity is impossible. However, in the face of adversity, we can strive to live a life of meaning and satisfaction. We do this by cultivating **resilience**, which is defined as “the process of adapting well in the face of adversity, trauma, tragedy, threats, or significant sources of stress, such as family and relationship problems, serious health problems, or workplace and financial stressors” (American Psychological Association, 2012). Not only is it “bouncing back” from difficult experiences, resilience also guides us to redirect future behavior in positive and healthy directions.

Resilience is not an inborn trait. It is a quality of mind that can be developed. You might know of someone who experienced a significant setback; worked through it with patience, self-compassion, support of family, friends, and community, and perhaps professional guidance; and set themselves on a life path toward greater stability, happiness, self-acceptance, and satisfaction. Here are some ways to build resilience (American Psychological Association, 2012):

- Cultivate supportive social relationships with empathic, understanding, accepting, trustworthy, and compassionate individuals. Avoid isolation. If reticent, force yourself to accept others' offers of help.
- Take care of your body with proper nutrition, adequate hydration, sufficient sleep, and regular exercise. Don't sit and worry, *move!*
- Take care of your mind with journaling, art, music, yoga, prayer, or meditation.

- Avoid using alcohol or drugs to cope with negativity, distress, and emotional pain.
- Find purpose by giving goodness to others through volunteering with civic, faith-based, or other organizations.
- Make molehills out of mountains. Accept problems as the way of things. Solve big problems by breaking them into manageable parts. Apply what you've learned from overcoming prior problems.
- Establish realistic goals and move toward them a step at a time. Ask yourself, "What one thing can I accomplish today that helps me move in the direction I want to go?"
- Focus on the good. Find opportunities in setbacks for personal and interpersonal growth.
- Be supportive of your efforts and strengths; ignore self-criticism and self-doubts of your worth. Be appreciative of the goodness that others bestow on you; ignore (don't engage) others' negativity.
- Keep things in perspective. Resist catastrophizing difficulties or assuming the world is against you. When overwhelmed, remind yourself that you're not helpless, "tomorrow is another day," and that you may be stressed out but you are still OK.
- Let go. Acknowledge that change is a part of life and certain goals or ideals may no longer be applicable to your current life or goals for the future.
- Be optimistic even when life isn't going your way. Visualize what you want rather than ruminate over what you've lost or any fears of the unknown.

- Get help to get unstuck from making progress in life or when you're unable to function as usual.
- Appreciate that you are not alone. Everyone is on a journey through life.
- Remember: There are many things in life over which you have little or no control. The one thing you can control, however, is yourself. And that's hard enough!

Ways to Promote Mind–Body Harmony and Health

Autogenic Training

Autogenic training uses autosuggestion—adopting ideas that you give yourself—to establish a balance between the mind and body through changes in the autonomic nervous system. The method has been shown to be effective in relieving anxiety (Miu, Heilman, & Miclea, 2009) and improving the quality of life in people with chronic medical conditions (Sutherland, Andersen, & Morris, 2005).

Autogenic training involves learning to concentrate on one of six basic autogenic phrases for a few minutes each day over a week or more. After weeks or months of practice, one is able to attain a deep sense of relaxation, often within seconds, which can result in healthful physiological changes. The six basic autosuggestions are as follows:

1. My arms and legs are heavy.
2. My arms and legs are warm.
3. My heartbeat is calm and regular.
4. My lungs breathe for me.
5. My abdomen is warm.
6. My forehead is cool.

The exact phrasing of any autogenic suggestion is not critical to its effectiveness. The words carry no particular power. Any suggestion can be rephrased so that it becomes comfortable, believable, and acceptable to the practitioner's mind.

A long-practiced type of autogenic training is **lovingkindness meditation (LKM)**, or *metta*. This practice involves reciting positive phrases toward oneself or another. The purpose of metta is to strengthen neurological connections in the part of the brain responsible for giving and receiving supportive emotional

interpersonal connections, the so-called friend and befriend region. LKM can be done at any time. Because the practice induces mind–body relaxation, many people find it beneficial when going to sleep. Here are steps for LKM:

1. Be in a quiet, restful, nondistracting locale.
2. Take two or three calming breaths (see the Wellness Guide “Self-Care: The Calming Breath” in Chapter 9) to deactivate the sympathetic nervous system and activate the parasympathetic nervous system.
3. Focus your attention on your heart region—perhaps place a hand on your heart—and say aloud or silently these phrases: “May I feel safe from inner and outer dangers.” “May I feel content.” “May I feel strong.” “May I live with ease.” You can choose other phrases that might feel more suitable, such as “May I be safe, peaceful, and free of suffering.” “May I be happy.” “May I be healthy.” As you recite the phrases, try to feel the emotion of caring—wholeheartedly wishing these states of well-being on yourself or someone else.

Biofeedback

Biofeedback consists of methods for using the mind to alter bodily functions. This method employs a recording device to facilitate learned self-control of physiological activities (see the Managing Stress box “Biofeedback”). The recording device is connected to a region of the body (e.g., forehead, arm), and information about biological activity in that region is “fed back” on a screen or by means of a sound to the person in whose body the activity is taking place. Using this visual or auditory information about the activity, the person can learn to control the activity in a desired way. Biofeedback has been used successfully to treat more than 150 medical conditions, including high blood pressure, back pain, panic attacks, asthma, and headaches (Mayo Clinic, 2021). Biofeedback also can be used to produce changes in the brain’s electrical activity (alpha

waves) to bring about a state of relaxation. Biofeedback involving only the brain's electrical activity is called *neurofeedback*.

Hypnosis and Healing

Hypnosis (from the Greek *hypnos*, meaning sleep) is a state of concentration and focused attention. The method typically involves attaining a relaxed mental state in which suggestions for imaginative experiences are presented by another person. This is called the *hypnotic induction*. Hypnotic suggestions can alter perception, sensation, emotion, thought, or behavior and, in this way, the mind can be focused on health issues. **Hypnotherapy** is the use of hypnosis to reduce pain, facilitate childbirth, decrease anxieties, manage body weight, and stop smoking.

We do not see things as they are. . . . We see things as we are.

—Talmud

To be successful therapeutically, hypnosis requires that (1) the participants are identified as the hypnotist and the client; (2) suggestions are a key to the procedure; (3) the client consents to participating in the procedure, especially to receiving and accepting suggestions; and (4) the therapist describes the technique beforehand and how it is supposed to help (Montgomery, Schnur, & Kravits, 2013). Success in hypnosis is greatly influenced by the rapport between client and hypnotherapist and the degree of the client's mental relaxation. This permits the mind to be open to suggestion rather than involved in a variety of thoughts.



Biofeedback

Dan was a first-year graduate student who experienced frequent headaches, for which he sought help from the Student Health Center. Medical tests showed no brain pathology such as a tumor, or brain infection or injury. Diagnosis: Dan's headaches were related to his stress and anxiety about doing well in graduate school.

Dan's therapy involved meeting with a counselor to discuss ways to manage the stress of graduate school and biofeedback training to deal specifically with his headaches. In biofeedback sessions, three small sensing devices, which monitored the activity of the forehead's frontalis muscle, were attached to Dan's forehead (**Figure 2.5**). The frontalis and certain muscles in the neck involuntarily contract during times of stress, which impedes blood flow to the head, resulting in a headache. Wires from the three sensors were connected to a biofeedback unit, which was placed on a table directly in Dan's view. Whenever Dan's frontalis muscle contracted, the biofeedback unit produced audible clicks. A highly tense frontalis produced rapid clicks. A relaxed frontalis produced infrequent, irregular clicks.

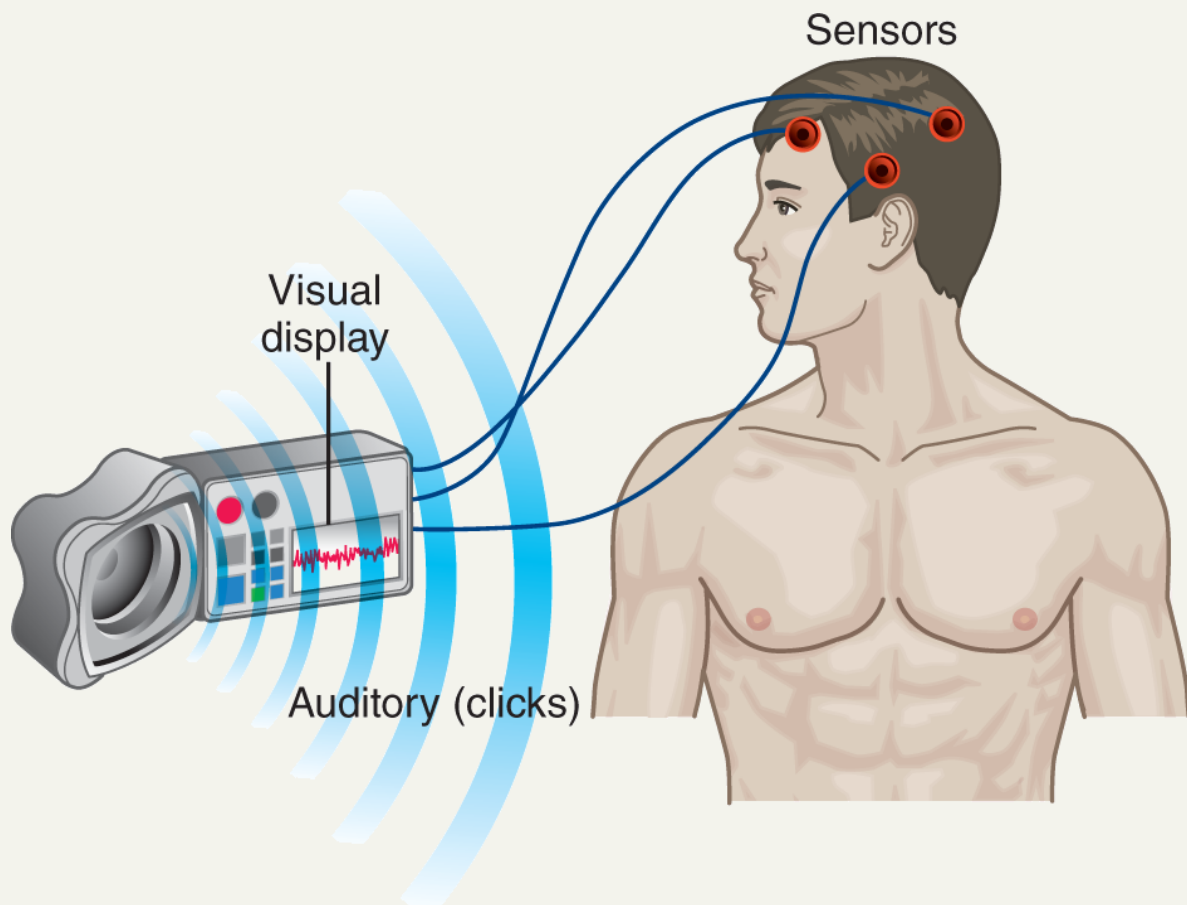


Figure 2.5 Biofeedback. The biofeedback device measures muscle tension in the head region. The speaker produces rapid audible clicks when muscles are tense and infrequent and irregular clicks when head muscles are relaxed.

Description

Dan was instructed by his biofeedback therapist to try to reduce the number of clicks, a skill that required several training sessions to attain. Paradoxically, not trying to relax his frontalis produced the best results. The therapy proved successful. Dan seldom got headaches. When he did, he could relieve them by relaxing the muscles in his forehead.

Many people have misapprehensions about being hypnotized, and many myths about hypnosis still exist. Perhaps the greatest fear people have is being induced to do something embarrassing, immoral, illegal, or evil when they are hypnotized. Some of the misconceptions and apprehensions about hypnosis are summarized in [Table 2.2](#).

TABLE 2.2	Myths About What Happens During Hypnosis
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Myth: While under hypnosis you lose control of your mind and the hypnotist can make you do anything that he or she wants.

Fact: Despite what is portrayed in movies, a hypnotist cannot control your mind or make you do something against your will or beliefs. A hypnotized person can decide to become “unhypnotized” at any time. Ultimately, all hypnosis is self-hypnosis. The stage hypnotist selects people from the audience who want to be hypnotized and be part of the act. People do funny things on the stage because they agree in their minds that it is OK to do them. Similarly, a person follows a therapist’s suggestions because of trust and a desire to be helped. No one can control your mind if you do not agree to cooperate.

Myth: Hypnosis is like falling asleep. You become unconscious and are unaware of what is happening around you. When you wake up you do not remember what was going on around you while you were hypnotized.

Fact: In hypnosis you do not lose consciousness, and most hypnotized subjects report that they feel fully aware. Hypnosis is like focused attention in which you are aware of specific thoughts to the exclusion of others. Just as with deep meditation, you are always in touch with reality and choose either to remain in the meditative state or “wake up.”

Myth: Hypnotists have special psychic or occult powers, which explains why they can control other people’s minds.

Fact: Hypnotists have trained their powers of observation and are skillful at giving suggestions. Those who claim to have special powers should be avoided because they harbor hidden motives and should not be trusted. Always remember that all hypnosis is self-hypnosis.

Myth: Only people with “weak minds” or of low intelligence can be hypnotized.

Fact: Everyone can be hypnotized, although people vary in that ability as they do in all abilities. Consider what happens in a movie theater. People laugh, cry, or are terrified by

what is happening on the screen. But the images that affect them so powerfully are, in reality, light on the screen. Most moviegoers are in a state of hypnosis and, by adopting the role of “moviegoer,” have agreed to allow their emotions to be manipulated by the images. Nevertheless, everyone is in control of their minds. Witness the sudden “unhypnotizing” if someone yells “Fire!” or if the lights are turned on abruptly. Again, it is worth emphasizing that all hypnosis is self-hypnosis.

Myth: Hypnosis is not useful or effective in improving health or harmful behaviors.

Fact: Hypnosis, or *hypnotherapy* as it is called when used by trained health professionals, may be especially useful in treating a wide range of symptoms. In 1957, the American Medical Association approved hypnotherapy as a valid therapeutic technique. Many physicians and clinical psychologists use hypnotherapy to treat a wide range of physical, emotional, and behavioral problems such as pain, panic attacks, smoking, alcoholism, and posttraumatic stress disorder.



Focusing Attention for Mind–Body Harmony

A wise teacher said that you could read thousands of books about focusing the mind, but none is as good as a demonstration. So, do this: Right now, notice the sensation of the bottoms of your feet touching the insides of the bottoms of your shoes. That sensation is caused by the nerves in the bottoms of your feet signaling your brain that your feet are touching your shoes. That signaling has been going on the entire time you’ve been reading this page, but you were unlikely to have noticed because your attention was focused on what you were reading—or perhaps on other thoughts—until you were asked to change the focus of your attention to the bottoms of your feet. This shows that you can choose to focus your attention (also called your *conscious awareness*) on what you want to: your feet, signals of discomfort from your body, worries, your to-do list, or memories of a nice time you had with someone special. Many mind–body methods involve becoming aware of what your mind is doing on a moment-to-moment basis and shifting the focus of your awareness from worry or busy mind to your breathing, a repeating sound or prayer, or an image. Instead of your mind being pushed and pulled this way and that by the busyness of your life, focusing your awareness on something calming or beautiful allows you to notice that your mind is overly busy—perhaps distressingly so—and to shift your mental process to something that facilitates feeling stable, in control, flexible, and adaptive.

Meditation

Meditation is a long-standing practice of focused awareness, trance induction, and relaxation. Contrary to what some people think, meditation is not a cult, a religion, or giving up control over one's mind. Neither is it being “zoned out” without thoughts or to escape reality. Instead, meditation is focusing on, paying attention to, and noticing what your mind is doing in the present moment without judging what you notice as “good” or “bad.” Just notice. If you examine what is going on in your mind at any given moment, you will probably find it flitting from one thought to another, which is called *chatter*: “Did I remember to turn off the lights before I left the house?” “My feet are killing me; I shouldn’t have worn these shoes.” “I wonder what will be on the math test?” Most of the time the human mind is active and often involved in worrying or thinking about emotional upsets, financial concerns, or the tasks and pressures of daily activities.

Quieting the mind is healthy, and meditation is a way to accomplish that through focused awareness (see the Managing Stress box “Focusing Attention for Mind–Body Harmony”). Various meditation practices can achieve mindfulness. For example, Zen meditation (*zazen*) involves sitting still with legs crossed while trying to empty the mind of its chatter. Transcendental meditation teaches focusing on a particular phrase (called a **mantra**) that is repeated internally; focusing the mind’s attention on a single phrase excludes other random thoughts. Insight or mindfulness meditation (*Vipassana*) teaches one to observe the flow of thoughts that pass through the mind without focusing on any particular one. It’s also possible to meditate by focusing attention on a piece of art called a **mandala** or an object such as a flower, an image that has colors and patterns but no specific content, or a body movement (walking or sweeping meditation) (see **Figure 2.6**). Prayer is a form of meditation that focuses awareness on God. Meditation is something

that nearly everyone has experienced even if they have not called it meditation.



Figure 2.6 Mandala. A mandala is a complex visual image used to focus attention and facilitate meditation. ("Green Tara" an original painting by Maile Yawata)

Courtesy of Gordon Edlin
Description

Meditation does not have to be done in a religious setting, nor is it complicated (see the Wellness Guide “Self-Care: Mindfulness Meditation for Lifelong Well-Being”). Most meditation practices focus attention on breathing—something you always have with you—and its various patterns can be the subject of focus. Is it slow and deep? Is it quick and shallow? Is it through one nostril or both?

As the meditator focuses awareness on breathing, the mind is highly likely to wander to various thoughts that stream by. Noticing that the mind is wandering, the meditator simply notes, “My mind is wandering,” and refocuses awareness on the breath. Novice meditators can count the breaths from 1 to 10 to help focus (counting is similar to a mantra). After some time, it is highly likely the mind will wander again. Noticing this, one doesn’t become frustrated or angry with oneself (“This isn’t working!” “I’m a bad meditator”). The mind’s job is to think, and wandering to thoughts in meditation demonstrates that. Meditation often comprises repeated cycles of focus and wandering (loss of focus). With some practice, it becomes easier to focus on breathing and letting thoughts stream in the background of the mind without paying much attention to them. Doing so engenders a calm state of being.



Self-Care: Mindfulness Meditation for Lifelong

Well-Being

Follow the directions below to learn how to practice mindfulness meditation. Online and mobile app training programs are listed below.

Directions

Become comfortable: Find a quiet place where you can sit in a chair. Sit straight, uncross your legs, and place your feet flat on the floor. Rest your hands in your lap or let them go

where they want to go. Take two easy, deep breaths, then breathe easily and naturally. Bring your shoulders down from your ears.

Step 1. Focusing on the feet: Close your eyes for 10 seconds and focus your awareness on the sensation of the bottoms of your feet touching the insoles of your shoes or the floor. After you open your eyes, note what your mind was doing while your eyes were closed.

Step 2. Focusing on the back: Close your eyes for 10 seconds and focus your awareness on the sensation of your back touching the chair. After a few seconds with your eyes closed, open your eyes, take an easy breath, and note what your mind was doing while your eyes were closed.

Step 3. Focusing on the breath: Close your eyes for 10 seconds and notice your breathing. Don't change your breathing rhythm or pattern, just notice the breath going in and out of your body.

You now know three basic meditation postures: (1) feet on the floor, (2) back against the chair, and (3) focus on the breath. With a bit of practice, you will discover which posture is best for you.

Step 4. Focusing for 30 seconds, and then 90 seconds: Become comfortable (see above). Choose one of the three meditation postures. Close your eyes and meditate by focusing your awareness for 30 seconds on your feet, back, or breathing (set your timer). While you're meditating, if you notice your mind wandering to this and that thought, refocus your awareness on your feet, back, or breathing. When the 30 seconds has elapsed, open your eyes and take a breath.

What did you notice while you were meditating? Did you hear sounds? Did your mind wander? Did you think about your to-do list? Did you tell yourself this was silly? Did you feel sleepy? Did you relax? All of these reactions are common. Whenever you meditate, you can expect your mind to wander and to think. When you notice that it does, just notice, and refocus your awareness on your feet, back, or breathing. *When you are ready, meditate again for 90 seconds.*

Don't expect to rid your mind of thoughts. You can't. The mind likes to think. When thoughts arise, let them pass through your mind like clouds in the sky. With practice, you'll see that you can choose whether or not to react to a thought instead of reactively grabbing onto it. You will have more control over yourself.

Step 5. Do Step 4 for 2 minutes on each of 2 days.

Step 6. Do Step 4 for 5 minutes on each of 2 days.

Step 7. Do Step 4 for 10 minutes on each of 5 days.

Step 8. Do Step 4 for 20 minutes nearly every day for the rest of your life.

Online and mobile app meditation training programs:

- Jack Kornfield and Tara Brach free 40-day online meditation course:
jackkornfield.com/free-mindfulness-daily-online-course/

■ Headspace: www.headspace.com

■ Free online course in mindfulness-based stress reduction: palousemindfulness.com/

Practicing meditation almost every day can help manage burnout and stress, increase the sense of well-being, lessen risks of a variety of illnesses and infections, deal with pain, increase a sense of harmony with your social and physical surroundings, get a good night's sleep, improve performance on tasks, and become aware of how mental processes affect one's life. College students take note! A mere four days of meditation training for 20 minutes a day can improve cognition and working memory (Chiesa, Calati, & Serretti, 2011; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010).

The faster the world becomes, the more we need to slow down.

Meditation is not what you think.

—Krishnamurti



Meditation can be done anywhere, any time.

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Make Up Your Own Mantra for Changing Behaviors

Use the power of a mantra to change some aspect of performance or behavior. Choose some behavior or activity that you would like to change or improve. Then create your own mantra. It should not be something complicated, but a small thing that you feel you can achieve. It should be as specific as possible. For example:

Sports:	I feel my body getting stronger.
	I feel my body moving more swiftly through the water.
	I become less tired each time around the track.
Behaviors:	I will stop eating when I feel full.
	I will not speak until the anger passes.
	My mind will stay alert during classes and exams.

Be creative in designing your own mantra and spend time each day reciting it internally while in a quiet state. You can be a skeptic and the mantra will still work.

The Relaxation Response

The **relaxation response** is an automatic physiological response that is the opposite of autonomic nervous system activation (Benson & Klipper, 2000). The relaxation response decreases oxygen consumption, respiratory rate, heart rate, blood pressure, and muscle tension. A variety of mind–body methods can produce the relaxation response such as mantra meditation, progressive muscle relaxation, and guided imagery. For example, at Harvard Medical School, patients are taught to sit quietly and silently repeat the word *one*. Methods that elicit the relaxation response share these features:

- a quiet environment;
- a focusing of the mind's attention, such as silently repeating a word or phrase, or focusing one's breathing;
- a passive, accepting mental state; and
- a comfortable physical position.

Practicing the relaxation response regularly for 10 to 15 minutes per day increases feelings of well-being and decreases depression, anxiety, and hostility, which is correlated with improved

cardiovascular and immune health (Chang, Casey, Dusek, & Benson, 2010).



Relaxation with Music

Many people know and research has shown that listening to or playing music can be relaxing (Daykin et al., 2018). Music can focus the mind just as meditation, hypnosis, and prayer do. Thus, listening to or playing music can reduce stress. In medical settings, music can help lessen patients' anxiety and stress. One study found that patients undergoing surgery were just as likely to be calmed by music as by sedative drugs (Petot et al., 2019). Music can help reduce the chronic pain that accompanies rheumatoid arthritis, herniated discs, or fibromyalgia. Music can help those who have experienced stroke, Alzheimer's, and other neurological diseases.

The kind of music that people find helpful varies according to individuals' preferences. In general, soft music is preferred to loud; gentle rhythms and moderate beats that approximate the heart rate (65 to 75 beats per minute) are preferred to vigorous or complex rhythms and fast beats. The "background music" found in doctors' and dentists' offices is known to reduce heart and breathing rates and reduce anxiety.

To use music as a therapy for insomnia, pain, stress, anxiety, or other problem, follow these guidelines:

- Choose music that you enjoy and find relaxing. Many types of classical music, soft jazz, Celtic and Native American music, and chants are suitable. Most people prefer music with flowing rhythms.
- Pick a time and place where you will not be disturbed and can let go of daily concerns. Plan to spend at least an hour in a relaxed state.
- You can listen at low volume or may feel more comfortable using ear-cupping headphones that reduce outside noise and distractions.
- Consider consulting a music therapist for additional advice and help.

Suggestion

Any time the mind becomes focused and relaxed, it also becomes more open to suggestion. This can be highly beneficial or it can create problems, depending on the kind of suggestions being received by the mind. Suggestions given as warnings, especially to children, who are particularly vulnerable to suggestion, can affect behaviors and cause health problems throughout life. For example, here are some common admonitions given to children that can cause health problems because young children believe what they are told.

- Put on your boots when you go out in the snow or you will catch cold.
- If you keep eating cookies, you'll get fat.
- If you don't try harder, you'll be a failure in life.
- If you climb those trees, you'll fall and get hurt.
- If you go out at night, the ghosts will get you.

Each of these suggestions predicts a negative outcome. To a child's mind, which is usually in a trancelike, suggestible state, these negative suggestions become fixed in the unconscious mind and may have harmful effects even many years later.



Positive Thinking Has the Power to Improve Health

- Become more aware of the power your mind has to improve health, hasten healing, and help you perform better in school and in other activities. Belief in yourself, in prayer, or in a particular treatment can facilitate healing and help prevent sickness.

- Use mental images that feel right to you to reduce exam anxiety and to improve performance in sports or other activities. Avoid negative mental images and thoughts such as “I feel lousy,” “I’m too tired to run,” “everyone will laugh at me,” or “I just know I can’t do that.” Use your mind to create positive images and thoughts. You can reverse what seems to be a “bad” day by suggesting to yourself that things are going to change and improve.
- Practice a daily mental-relaxation technique in a place that is comfortable and quiet. Use the time to “talk” to your body to promote healing or to change behaviors. Visualize scenes from your past or ones you can imagine in the future that you know are calming, healthy, and constructive. As you become more adept at using your mind, you will find new ways to use mental relaxation in all aspects of your life. (Notice how we inserted a positive suggestion.)

The mind can be made more open to suggestion by many things we are exposed to in daily life. For example, movies and television focus attention with both images and sound. As a consequence, they can induce a trancelike state and cause us to cry, laugh, and become angry or upset; they can actually manipulate our emotions through light and sound. No one dies on a movie screen, but we often react as if they did. The violence and horror people watch in movies and on TV often do affect both physical and emotional states. As a result of watching some frightening scene, people may actually become sick for days, weeks, or years when something reminds the subconscious mind of the scene and brings back the fear.

Advertisers know how to take advantage of viewers’ suggestible, hypnotic states of mind. Television programs usually are interrupted at an emotional peak in the story by advertising a product while viewers are still in a suggestible state of mind. Many people believe they are not influenced by advertising, but marketing studies indicate otherwise. Most advertisers try to persuade people to buy products they usually do not need. It is important to become more aware of how suggestible you are and to protect yourself from both obvious and subtle suggestions that can damage your health and peace of mind.

A highly effective way to use suggestion to promote wellness and to change undesirable behaviors is through the use of **image**

visualization. Many mind–body healing techniques employ some form of image visualization. For example, frightening scenes from the past, especially from early childhood, can be reexperienced while a person is in a state of mental relaxation brought on by hypnosis or some other technique. As the scenes and emotional upsets are visualized in the mind, they can be reinterpreted and reprogrammed to change their negative effects on health and behaviors. Mental imagery can also be used to reduce pain; hasten healing; improve performance in sports; change smoking, drinking, or eating behaviors; and help control compulsive urges to gamble. At one time or another in our lives, we all daydream or run an “internal movie,” fantasizing our hopes and fears. During such fantasies we visualize experiences and create feelings. Image visualization can change body temperature, blood flow, heartbeat, breathing rate, production of hormones, and other body processes regulated by the brain.

Most psychologists who work with athletes to improve physical performance use image visualization. The so-called inner games of tennis, golf, skiing, and skating are based on image visualization. Baseball players in a batting slump use relaxation and visualization to “see” themselves getting hits. Basketball players use the technique to “see” their free throws going cleanly through the hoop.

Image visualization also can improve sexual responses and enjoyment. Sexual arousal begins in the mind, and negative thoughts or fears can stifle the sexual responses. The sex organs are particularly sensitive to images generated in the mind. Most sex therapists use relaxation techniques and image visualization to help clients improve their sexual experiences. Tension related to sexual performance is usually the main reason for not experiencing the desired sexual sensations. In all areas of your life, begin to use your mental powers more to enhance health and improve performance in daily tasks.



Image Visualization Reduces Stress

Image visualization is telling yourself a story and “seeing” the images in your mind’s eye. An attorney in Los Angeles periodically uses image visualization during the first few minutes of her lunch break. She closes the door to her office, takes off her shoes, and sits on the floor with her back against a wall. She closes her eyes and takes a few deep breaths. Then she imagines . . . that she is standing at the edge of a meadow that is filled with golden wildflowers. The sun is shining and the air is at a pleasant temperature. On the far side of the meadow is a hill. She imagines herself slowly walking across the meadow toward the hill on a path that has been worn down by previous walks through the flowers.

When she reaches the hill, she begins to walk on a gently winding path toward the top. As she walks, she hears the sounds of birds and a nearby stream. Along the side of the path she sees bushes, small trees, a few flowers, and a few stones. Finally, she reaches the top of the hill, where there is a lovely stand of tall trees. There’s a clearing in the trees, and on one side of the clearing there’s a fallen log. She sits on the log and enjoys the warm sun filtering through the branches of the tall trees. She closes her eyes and rests. After a few minutes, it’s time to return, so she opens her eyes, rises, and walks across the clearing to a very large, smooth, white boulder. She looks on the top of the boulder and there’s a private message written just for her. She reads the message and then begins to walk down the path to the meadow, still hearing the sounds of the birds and the stream, and still feeling the warm sun. Eventually she reaches the meadow, retraces her path through the golden flowers, and then . . . she opens her eyes and embarks on the rest of her workday.

Guided imagery is another application of suggestion to promote health and well-being and to relieve stress. Unlike image visualization, in which the image is created by oneself, in guided imagery another’s verbal suggestions help guide you to create a particular physical response such as reducing stress, lowering blood pressure, or reducing pain. Often, a guided imagery experience begins with the guide suggesting that you take a few moments to settle from the day’s usual “busyness” by sitting or lying comfortably, closing your eyes, and taking some deep breaths. Then the guide may suggest images of you being in a peaceful locale such as beside a mountain stream or at an isolated beach. The guide will describe in great detail the scene and remind you how peaceful and

serene you feel. In the mountains you may be guided to see flowers in a meadow or birds flying overhead and to be soothed by the imagined sound of water flowing in a stream. You might be guided to imagine the water carrying away your worries and tension. At the beach you may be guided to sense the warm sun on your skin and hear the sound of waves coming ashore. As the water retreats to the sea, it carries away some of your worry, tension, or pain. After a few minutes, your guide will suggest that it is time to leave your serene place and you are guided back to your normal environment. As you return, your guide reminds you how relaxed and good you feel and encourages you to carry that feeling with you as you move through the rest of your day.

Virtual Reality Therapies

Distraction has been known to be a highly effective treatment for pain for many centuries. That is why meditation, hypnotherapy, prayer, and other methods that focus the mind's attention on something other than pain or other symptoms are so effective. Many Buddhist monks and devout individuals of many faiths learn to focus their attention so completely on a mantra, mandala, breathing, or exalted inner state that they are, quite literally, "out of their bodies." Modern medical researchers are using this aspect of mind to create **virtual reality therapy (VRT)** to treat burns, pain, and phobias (e.g., fear of flying, insects, or heights). Virtual reality therapy involves focusing one's attention on a computer-generated imaginary world. A medical application of VRT exposes burn patients to virtual realities of glaciers, ice, snow, snowmen, and other features of a cold world to distract them from their pain. Another application of VRT is to help stroke patients to improve their gait and posture (Park, Lee, & Lee, 2013). While in the fearful virtual world, patients are safe in their therapist's office and know they can remove the headset at any time. Because part of their mind knows they are safe, patients can confront their fears in the virtual world and learn to overcome them.

An especially important use of VRT is in the treatment of posttraumatic stress disorder (PTSD), which was experienced by many survivors of the 9/11 attack in New York and by soldiers who served in Iraq (Morina, Ijntema, Meyerbröker, & Emmelkamp, 2015). Examples of environments simulated are virtual Iraq, virtual airplane, virtual nicotine, and virtual 9/11. Patients using VRT can manipulate the virtual environments to lessen their fears and stress. Some manage to reduce their overall anxiety and arousal response so that they become relatively free of PTSD.

The software for virtual reality therapies is costly to develop, and so is the equipment to deliver the therapeutic treatments.

Nevertheless, virtual reality therapy has enormous potential to help people overcome a variety of fears and symptoms of fear.

Taking Time Out to Quiet the Mind

Most of us live fairly hectic lives that are full of time pressures and mental stress. Most young people go to school, work at a job, or both. In addition to school and work, students engage in extracurricular activities, sports, concerts, smartphone conversations, computer chat rooms, video games, movies, television—the list goes on and on. To do all these things requires a healthy mind and body. Usually, health is something young people take for granted until it disappears. But staying healthy, even when you are young, means finding time to be quiet, silence stressful thoughts, and alleviate tensions in the body.

There are many ways to quiet down, and some suggestions and techniques have been presented in this chapter. But the best ones are the ones that you discover for yourself. Find a quiet spot in a park or in your yard where you can sit and reflect on the good things in your life. Forget for a time the problems of the world and what you need to accomplish. Just notice things around you, especially the small things. Watch an ant carry a bit of food twice its size. Look at the pattern of stars in the night sky. Experiencing the freshness of new snow or the taste of rain. Be quiet as often as you can. It's good for your mental and physical health.

Critical Thinking About Health

1. Identify one time in your life when you have been seriously ill (not counting colds or minor injuries). Describe the nature of the illness and the time it took to become well again. Discuss all of the factors that you think may have contributed to your becoming sick, including stress, emotional problems, poor nutrition, and so forth. Then discuss all of the factors that you believe contributed to your becoming well again, including medical care, prayer, family support, alternative medicines, and other factors. What were the most important factors that led to your becoming sick? What were the most important ones in the healing process?
2. In your opinion, what is the role of religion or spirituality in health? To what degree should religion or spirituality be part of a clinical encounter between a patient and a health practitioner?
3. Describe any experiences you have had with meditation, hypnosis, yoga, qigong, image visualization, or any other form of mental focusing and relaxation. Describe how you became involved with this activity and for what purpose you used it. Did it help you solve a particular health or emotional problem? Would you recommend this technique to others?

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Our bodies and brains are intimately interconnected. The brain controls thousands of chemical reactions in the body moment by moment; conversely, the state of the body directly affects thoughts, feelings, and emotions. Optimal health depends on maintaining mind–body harmony so that both work together to keep you feeling well, energetic, strong, and aware of yourself and others. The brain automatically regulates essential functions of the body such as breathing, digestion, blood pressure and flow, and reaction to the environment such as stopping you from walking in front of a moving car or pulling your hand away from a flame. Most brain activities occur without conscious control. But the mind can be trained through various mental and physical techniques to be more effective in healing illnesses and injuries. On the other hand, if your mind is disturbed, anxious, or depressed, it can cause bodily organs to malfunction, thus leading to illness. A dramatic example of the mind's power to affect health is the placebo effect. If a person believes in the power of a pill to cure or prevent disease, taking such a placebo pill will often work as well as a prescribed drug. Belief can heal because the mind has the power to change body chemistry.

Just as the body can be trained to do certain things, the mind also can be trained to calm anxieties and to facilitate healing. Techniques such as meditation, hypnosis, image visualization, and many others increase awareness of thoughts, reduce stress and emotional upset, and even alter body chemistry to promote healing and health. Learning and practicing meditation regularly or another of several mental relaxation techniques can provide lifelong tools for improving health and coping with upsetting situations that one encounters in life.

HIGHLIGHTS

- The human mind can cause changes in body chemistry through thoughts and feelings, which may have a positive or negative effect on your health.
- Optimal health is achieved when the mind and body communicate harmoniously.
- Disease can be regarded as disruption of homeostasis or disruption of the harmonious interaction of mind and body.
- The mind and organs of the body communicate continuously via the autonomic nervous system, which maintains vital body functions such as heart rate, level of blood sugar, and temperature.
- Psychosomatic illnesses are physical symptoms caused by stress, anxiety, and emotional upsets.
- Somatic symptom disorders are caused by psychosocial problems.
- The placebo effect often is almost as powerful as drugs in treating symptoms of illness.
- Hypnosis and meditation can play a positive role in healing illnesses.
- Belief, faith, and suggestion all have the power to heal because the mind can change disturbed body functions and reestablish homeostasis.
- A key to maintaining or improving health and wellness is to learn and practice a mental-relaxation technique.

- Image visualization can be used to reduce anxiety and stress, modify behaviors, and enhance performance.
- Virtual reality therapies use computer software to treat phobias and severe pain.

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KEY TERMS

autonomic nervous system (ANS):

the special group of nerves that control some of the body's organs and their functions

hormones:

chemicals produced in the body that regulate body functions

immune system:

an interacting system of organs and cells that protect the body from infectious organisms and harmful substances

placebo effect:

healing that results from a person's belief in a treatment that has no medicinal value

nocebo effect:

the opposite of placebo effect; a harmless substance that has harmful, undesirable, and adverse effects on health

psychosomatic:

physical illnesses brought on by negative mental states such as stress or emotional upset

resilience:

defined by the APA as the process of adapting in the face of adversity, trauma, tragedy, threats, or significant sources of stress

autogenic training:

the use of autosuggestion to establish a balance between the mind and body through changes in the autonomic nervous system

lovingkindness meditation (LKM):

reciting positive phrases toward oneself or another; also known as *metta*

biofeedback:

using an electronic device to “feed back” information about the body to alter a particular physiological function

hypnosis:

state of concentration and focused attention

hypnotherapy:

the use of hypnosis to treat sickness

meditation:

focusing awareness on a self-produced inner sound (“mantra”) or an external sound, or image, or one’s breathing to lessen attentiveness to external stimuli

mantra:

a sound or phrase that is repeated in the mind to help produce a meditative state

mandala:

an artistic, religious design used as an object of meditation

relaxation response:

the physiological changes in the body that result from mental relaxation techniques

image visualization:

use of mental images to promote healing and change behaviors

guided imagery:

using verbal suggestions to create one’s own mental images that produce relaxation and feelings of harmony, and reduce stress

virtual reality therapy (VRT):

use of computer programs to create virtual worlds that engage the mind in order to overcome pain and fear and to treat symptoms of posttraumatic stress disorder



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CHAPTER 3

Managing Stress: Restoring Mind–Body Harmony



Health Tips

Warning Signs of Stress

Worry, Worry, Worry: How to Stop Stressful Thoughts

Visualization Reduces Exam Anxiety



Global Wellness

Overwork Causes Death in Japan

Climate Change Stress



Managing Stress

Two Monks and the River



Wellness Guide

Self-Care: Sinking Into the Floor

The Powerful General and the Monk

LEARNING OBJECTIVES

1. Define the terms *stress*, *stressor*, *eustress*, and *distress*.
2. Describe the environmental, mental, and emotional components of stress.
3. Describe the physiological components of stress.
4. Describe four ways that stress causes illness.
5. Define problem-focused and emotion-focused coping.
6. Explain how college students can manage overload and test anxiety and practice time management.

Health Instructor (to class): What stresses you?

Student 1: Not enough money.

Student 2: My relationship. It's like a five-credit class.

Student 3: Econ pop quizzes.

Student 4: No, all tests.

Student 5: All of that!

College students are particularly familiar with stress and its associated feelings of being overwhelmed and by anxiety, frustration, anger, and depression. Along with these, stress can engender sleeplessness, fatigue, gastrointestinal upset, headache, muscular tension, increased susceptibility to infections, and invitations to engage in unhealthy behaviors (e.g., smoking, drinking, unsafe sex).

Stress is a disruption in one's psychobiological balance and sense of harmony within oneself and with the social and physical environments. The experience of stress is unpleasant, so when we become stressed, we try to regain psychological and physical balance. If we are successful, we not only feel better but also gain confidence in our ability to handle stress in the future. If we are not successful, however, and stress is prolonged or severe, we may feel helpless and become fatigued, worn out, and sick (**Table 3.1**).

TABLE 3.1 Disorders That Can Be Caused or Aggravated by Stress

Gastrointestinal Disorders	Musculoskeletal Disorders
Constipation	Rheumatoid arthritis
Diarrhea	Low back pain
Duodenal ulcer	Migraine headache
Ulcerative colitis	Muscle tension

Gastrointestinal Disorders	Musculoskeletal Disorders
Respiratory Disorders	Metabolic Disorders
Asthma	Hyperthyroidism
Hay fever	Hypothyroidism
Tuberculosis	Diabetes
Colds	Overweight
Flu	Metabolic syndrome
Skin Disorders	Cardiovascular Disorders
Eczema	Coronary artery disease
Pruritus	Essential hypertension
Urticaria	Congestive heart failure
Psoriasis	Menstrual Irregularities
Eating Disorders	Cancer
Depression	Accident Proneness

In this chapter, we discuss stress and suggest ways to reduce it.

One of the lessons of history is that nothing is sometimes a good thing to do, and often a clever thing to say.

—**Will Durant**, American historian

How Stress Occurs

Stress results from the interplay of environmental situations and life events and the mental (cognitive), emotional, and physical reactions to those occurrences (**Figure 3.1**). Stress experts define stress as “a relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being” (Folkman, 1984). In other words, stress comes from thinking, “This situation puts my well-being at risk and I’m not sure I have the personal, social, economic, or physical resources to meet this challenge and come out OK.”



Figure 3.1 The Components of Stress. Stress results from the interplay of potentially stressful environmental situations and life events and the mental (cognitive), emotional, and physiological reactions to those occurrences.

Description

The Environmental Component of Stress

The environmental component of stress consists of situations and events that bring about stress. Stressors can be the day-to-day hassles and complexities that block the efficient and timely accomplishment of daily life tasks, family problems, unpleasant

interactions with other people, job and school problems, major external events (war, flood, famine), and major life changes and events that become obstacles to achieving desired life goals. Positive experiences, such as starting a new love relationship or graduating from college, although positive, can also be taxing. In general, stressful situations can be classified into these types:

1. **Harm-and-loss situations**, which include death of a loved one, loss of an important relationship, theft or damage to one's property, physical injury or loss of a body part, physical assault, or loss of self-esteem.
2. **Threat situations**, which are *perceived as likely* to produce harm or loss whether any harm or loss actually occurs. The experience is one of continually watching for and warding off potential dangers (*hypervigilance*).
3. **Challenge situations**, which are perceived as opportunities for growth, mastery, and gain. The stress that comes from challenging situations is called **eustress** (positive stress), as opposed to **distress** (negative stress) that accompanies harm, loss, and threat.

The Mental Component of Stress

The mental component of stress consists of (1) the appraisal of a situation as absolutely or potentially damaging to one's physical or psychological well-being or a threat to one's survival, and (2) believing that one's personal resources are insufficient to ward off or overcome the threat to one's well-being. The situation can be real, such as breaking up in a relationship, or imagined, such as the possibility of a pop quiz that may or may not happen.

The degree to which a situation is appraised as stressful depends on an individual's psychological makeup. Everyone interprets the world and events differently. Thus, a situation that is upsetting and stressful to one person may not even bother another.

The Emotional Component of Stress

The emotional component of stress consists of unpleasant emotions that arise from one's appraisal of a situation as harmful or threatening and that one's resources for protection are limited or uncertain. These emotions are anxiety, fear, frustration, anger, and depression.

Factors Affecting the Experience of Stress

Several factors influence the degree of stress a person experiences. Among them are predictability, personal control, belief in the outcome, and social support.

Predictability

Knowing when a stressful situation will occur produces less stress than not knowing. This is because knowing when a stressful event will occur (like taking an exam) allows a person to relax in the interim and prepare to face the challenge, whereas not knowing puts a person on constant alert (like having to face pop quizzes). For example, people whose employment status is secure have less stress than people who must worry constantly about losing their jobs (Harknett & Schneider, 2020). At one point during World War II, London was bombed every night, but the London suburbs were not. Londoners had fewer ulcers than suburbanites, presumably because they knew when bombings would occur (Jones, 2012).



Warning Signs of Stress

Although stress is pervasive in the life of a college student, it is not always easy to recognize when stress has become a threat to physical or mental health. If you experience any of these signs of stress, it's time to make some changes in your life and perhaps seek professional help to reduce the stress.

- Trouble falling asleep
- Difficulty staying asleep

- Waking up tired and not well rested
- Changes in eating patterns
- Craving sweet, fatty, salty (“comfort”) foods
- More headaches than usual
- Short temper or irritability
- Recurring colds and minor illnesses
- Muscle ache or tightness
- Trouble concentrating, remembering, or staying organized
- Depression



Self-Care: Sinking Into the Floor

This exercise is also a yoga pose called *savasana* or the corpse position. Its purpose is to quiet the mind and body. Practice for 10–15 minutes several times a week, especially after prolonged stress or physical activity such as work or exercise.



Directions

1. Put yourself in quiet, comfortable surroundings.
2. Shoes off, clothes loosened.
3. Lie on your back; palms facing upwards.
4. Set your heels slightly apart with feet pointing slightly outward.
5. Gently press your lower back into the floor; then release to allow the natural curve of the spine.
6. Close your eyes; breathe naturally.
7. Slowly, from feet to face, progressively scan your body to find regions of tension. As if it were a sponge, imagine the surface on which you are lying drawing any tension out of your body.
8. Observe thoughts without focusing on them; if caught up in thought, focus awareness on breathing or a point of contact with the floor.
9. After the body scan, lie quietly for at least two minutes (10 is better) and observe the sensations that follow.

Personal Control

Individuals who believe they can influence the course of their lives are likely to experience less stress than individuals who believe their fate is determined by factors beyond their control. The crucial factor is belief in one's ability to control situations and not whether control is actually possible. For example, scholarship athletes at Division I colleges who believe they have little control over their circumstances experience more stress than athletes who feel they are in control of their own destiny (Holden, Forester, Williford, & Reilly, 2019).

Belief in the Outcome

People who believe that things are likely to improve (optimists) experience less stress than do people who believe that things will get worse (pessimists).

Social Support

Having someone to talk to and believing that the person can help manage a **stressor** by providing physical, emotional, or intellectual help lessens stress (Taylor, 2011). For example, breast cancer patients experience less stress if they have social support (Gudenkauf & Ehlers, 2018). Also, patients who talk to their surgeons about their fears of an impending surgery have a smaller stress response than patients who go through such procedures feeling uninformed and unsupported.

The Physiological Component of Stress

The physiological component of stress consists of automatic physiological responses to real or imagined situations that are considered damaging or threatening. One physiological response to stress is called the **flight–fight–freeze response (Figure 3.2)**. Its purpose is to enable an individual to deal with a perceived or actual threat by running away or avoiding it (flight), confronting it (fight), or becoming nonvolitionally immobile and silent (freeze, or “playing dead”). The flight and fight responses are coordinated by the sympathetic division of the autonomic nervous system; the freeze

response by the parasympathetic division. The flight and fight responses involves the release of adrenaline (also called *epinephrine*) from the adrenal glands (located in the thorax above the kidneys). This elevates the heart rate and blood pressure (to provide more blood to muscles), constricts the blood vessels of the skin (to limit bleeding if wounded), dilates the pupil of the eye (to let in more light, thereby improving vision), increases activity in the reticular formation of the brain (to increase the alert, aroused state), liberates glucose and free fatty acids from body storage sites (to make energy available to the muscles, brain, and other tissues and organs), and activates certain immune cells to prepare to defend the body if wounded. The freeze response includes loss of tone of skeletal muscles (to create predator's disinterest or to maintain blood flow to the brain if wounded), a drop in blood pressure (to reduce blood loss from wounds), and tightening of the larynx (to inhibit vocalization).



Figure 3.2 The Flight–Fight–Freeze Response. All humans display this response when confronted with challenges they interpret as frightening or threatening.

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The Powerful General and the Monk

The powerful general and his army arrived at the border of a neighboring country. Scouts were sent into the countryside to reconnoiter. After a time, a scout returned. Throwing himself off his horse, he knelt at the powerful general's feet and bowed his head.

"What is your report?" barked the powerful general.

"Master," replied the scout. "hearing that your magnificent and powerful armies have landed, all for miles around have fled."

The powerful general stood proudly and smiled. The scout looked up ever so meekly and continued, "Except the monk."

"What?!?"

"Yes, sire, except the monk. He has not fled."

"Where is this foolish monk?" bellowed the powerful general.

The scout looked up. "In the village, sire, not 15 minutes ride from here. He is in his hut at the top of the hill."

The powerful general, by now enraged, strapped on his sword and armor, mounted his massive white horse, and galloped south along the coast road. At the village he sped up the hill and quickly dismounted in front of the monk's hut. Drawing his sword from its scabbard, the powerful general burst into the hut. There, a small man in clean but tattered robes, with a shaved head, was sitting on a cushion, meditating.

The powerful general placed the tip of his sword at the monk's throat, and in his deepest, most commanding voice said, "You dare not flee before my powerful armies? Do you realize I could run you through with my sword without blinking an eye?"

The monk opened his eyes, looked at the general, and said, "Do you realize that I could let you run me through with your sword without blinking an eye?"

The powerful general thought for a moment. Then he put the sword back in its scabbard, bowed to the monk, and rode away.

A second physiological response to stress is activation of the **hypothalamo–pituitary–adrenal (HPA) axis** (Figure 3.3). The thought that one is in a harmful or threatening situation causes the hypothalamus of the brain to release a hormone called *corticotrophin releasing factor* (CRF). This hormone stimulates the pituitary gland (located at the base of the brain) to release a hormone called

adrenocorticotrophic hormone (ACTH) into the bloodstream. ACTH circulates in the blood and stimulates the pair of adrenal glands to release into the blood yet another hormone called *cortisol*. In the immediate (acute) response to stress, this hormone circulates in the blood, causing tissues to respond to the stressor, generally by providing energy for confrontation (fight) or avoidance (flight), for fighting infection, and for healing wounds. However, in the extended (chronic) response to stress, this hormone alters metabolism, contributing to overweight and type 2 diabetes; suppresses the immune system, thereby increasing susceptibility to infections and cancer; weakens bones; impairs memory; and worsens depression.

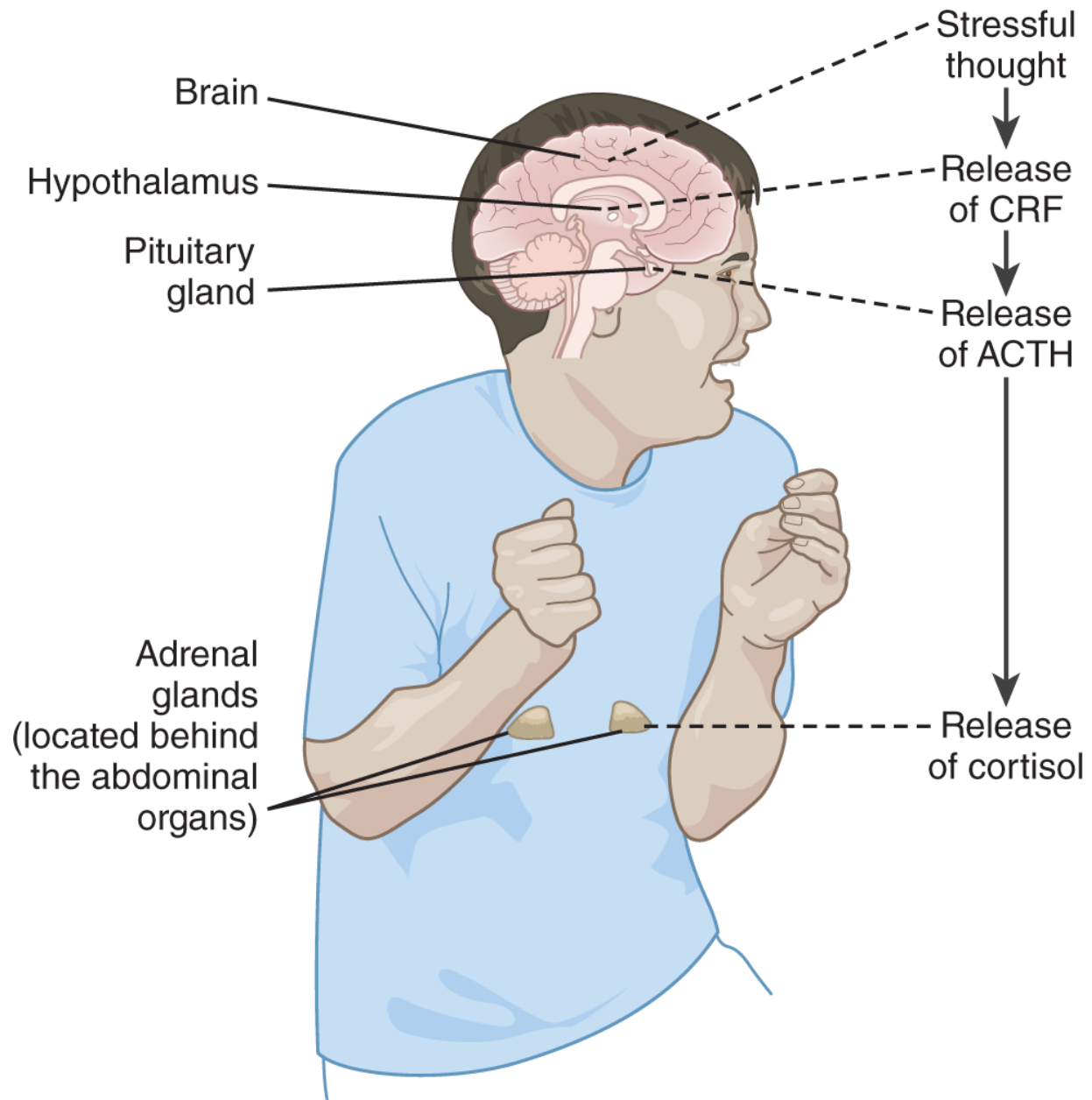


Figure 3.3 The Hypothalamo-Pituitary-Adrenal Axis. Stressful thoughts trigger the release of a hormone called *corticotrophin releasing factor* (CRF) from the hypothalamus region of the brain. CRF flows in the bloodstream to the pituitary gland, where it stimulates the release of the hormone ACTH, which circulates in the bloodstream to the adrenal glands, where it stimulates the release of cortisol and other stress hormones. In acute stress, cortisol helps prepare the body for fight, flight, wound healing, and potential infection. In chronic stress, cortisol unbalances metabolism and suppresses the immune system.

Description



Overwork Causes Death in Japan

Stress not only can increase a person's susceptibility to infections and sickness but also can cause death, as recognized years ago in Japan and more recently also in China. Many people in Japan and China work long hours and sometimes are asked to take on more work than they can handle. The stress from overwork can raise blood pressure, lower immune system functioning, and cause heart rhythm disturbances that result in sudden death. In Japan, sudden death from overwork is called *karoshi*. China has adopted the Japanese term. The major causes of *karoshi* deaths are heart attack and stroke.

In 1987, the Japanese Labor Ministry officially recognized *karoshi* (overwork) as a cause of death. The ministry estimates that hundreds of people die each year from overwork. This number does not include those who die of suicide. In 2011, a jury awarded the parents of a Japanese car factory worker \$700,000 in damages after a court ruled their son committed suicide because he was overworked. The number of yearly deaths from *karoshi* in China is estimated to be 600,000.

The flight, fight, and freeze responses and activation of the HPA axis are designed for short-term (minutes to hours) management of a stressful situation. If the individual can think differently or do something to change the perception that the situation is overwhelmingly threatening, stress activation of the nervous system and the secretion of stress hormones stop and the person's mind and body return to balance. This can be accomplished by attempting to change the stressful situation, changing one's interpretation of it, or thinking that the situation is manageable rather than overwhelming. If nothing changes, however, and the stress response continues, then a person can feel anxious, depressed, irritable, fatigued, and burned out, and the risks of becoming both mentally and physically ill increase.



Stress can cause unhealthy behaviors such as smoking.

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How Stress Contributes to Illness

Stress contributes to illness by (1) causing the mind and body to become exhausted, worn down, and damaged; (2) weakening immunity; and (3) motivating unhealthy behaviors in an attempt to deal with stress (**Figure 3.4**). Some people who have been exposed to a life-threatening, traumatic experience, such as a car crash, combat, sexual violence, abuse, and maltreatment, can develop **posttraumatic stress disorder (PTSD)**, unpleasant and often debilitating symptoms that persist for months and years after the traumatic experience (discussed later in this chapter).

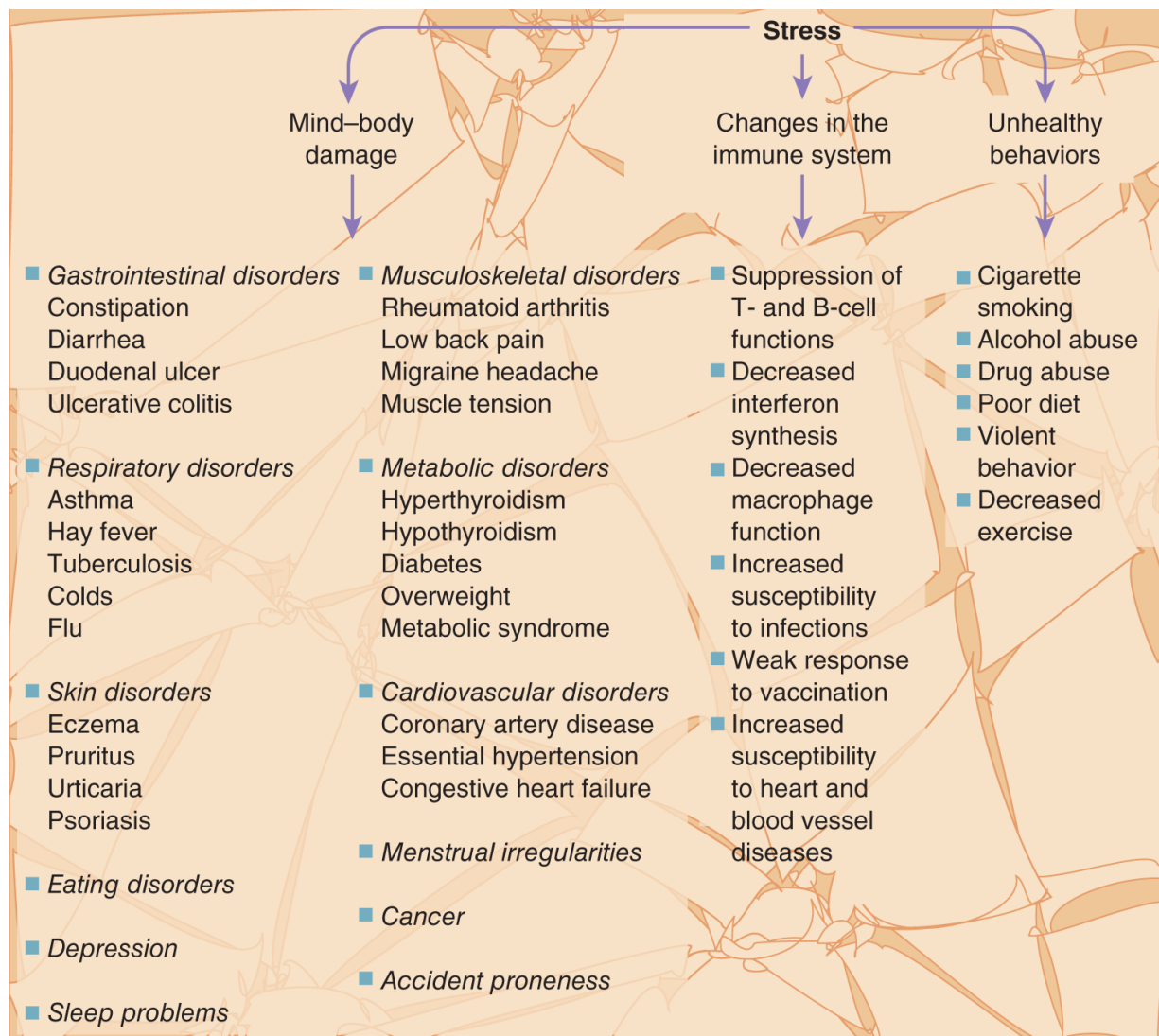


Figure 3.4 The Stress–Illness Relationship. Stress contributes to illness by causing the mind and body to become exhausted, worn down, and damaged; by weakening immunity; and by fostering unhealthy behaviors.

Description

Heavy thoughts bring on physical maladies; when the soul is oppressed so is the body.

—Martin Luther

The General Adaptation Syndrome

Continual physiological response to stressors can bring about a three-stage biological response called the **general adaptation syndrome (GAS)** (Figure 3.5):

1. *Stage of alarm*: A person's ability to withstand or resist any type of stressor is lowered by the need to deal with the stressor, whether it is a burn, a broken arm, the loss of a loved one, the fear of failing a class, or the loss of a job.
2. *Stage of resistance*: The body adapts to the continued presence of the stressor by producing more epinephrine, raising blood pressure, increasing alertness, suppressing the immune system, and tensing muscles. If interaction with the stressor is prolonged, the ability to resist becomes depleted.
3. *Stage of exhaustion*: When the ability to resist is depleted, the person becomes ill. Because many months or even years of wear and tear may be required before the body's resistance is exhausted, illness may not appear until long after the initial interaction with the stressor.

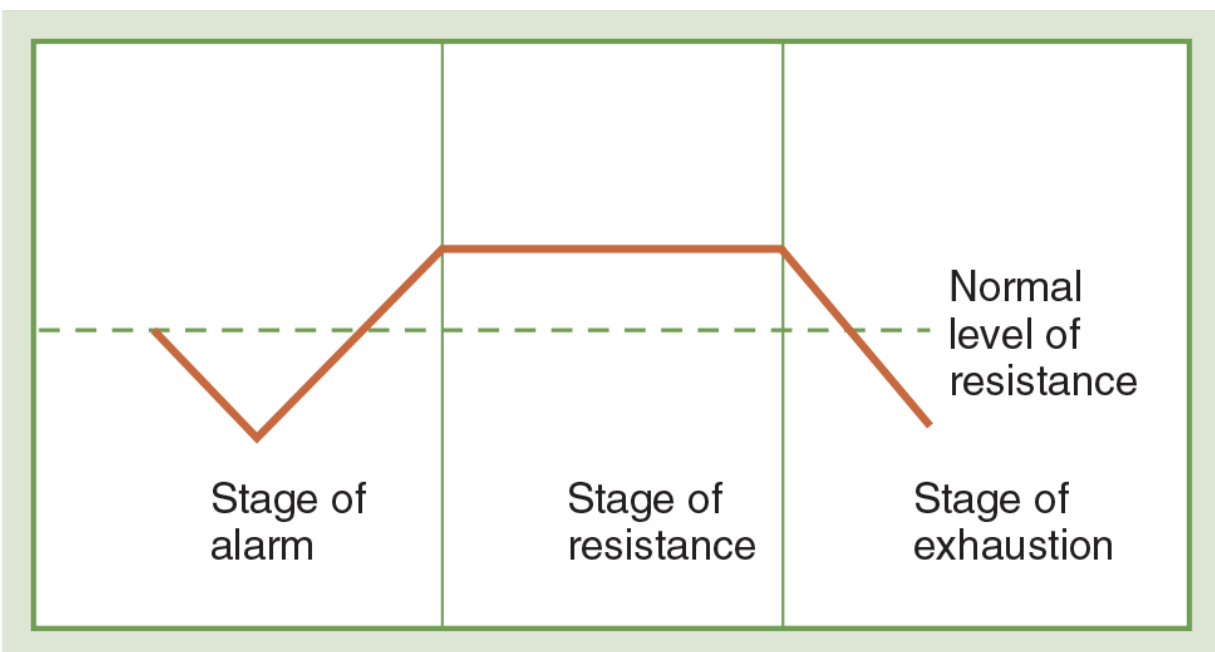


Figure 3.5 The General Adaptation Syndrome. In the stage of alarm, the body's normal resistance to stress is lowered from the first interactions with the stressor. In the stage of

resistance, the body adapts to the continued presence of the stressor and resistance increases. In the stage of exhaustion, the body loses its ability to resist the stressor any longer and becomes exhausted.

Description



Worry, Worry, Worry: How to Stop Stressful

Thoughts

If you have the same worrisome thought over and over, try this:

Stop the thought when you realize you are having it. Say to yourself, "There's that worry again. Stop!"

Replace the thought with a more positive thought.

Here's an example: A student realizes that when he looks at his watch to see how much time remains on a test, he immediately has the thought "There's not enough time." This thought comes over and over again, stressing him and disrupting his focus. After he learns thought stopping, the next time worry rumination occurs, he stops. He puts down his pencil, closes his eyes, focuses his attention to his feet on the floor, takes a deep breath, and says to himself, "There's that thought again. I can do this test if I focus." A few seconds later, the thought recedes, his mind is clear, and he returns to the exam.

Stress Weakens Immunity

A variety of studies have shown that stress can impair the functions of the immune system (Straub & Cutolo, 2018). For example, students who experience considerable stress prior to taking exams show reduced blood levels of immune system cells (e.g., natural killer cells, T cells), thus making exam stress a risk factor for colds, flu, and other infections. Stress also slows the body's ability to mount an immune response to a vaccine. Furthermore, stress impairs immune functioning in people who have lost their jobs, recently experienced the death of a loved one, or are unhappily married, never married, or recently divorced.

The man who fears suffering is already suffering from what he fears.

—Montaigne

Stress-related impairment of the immune system is mediated by stress hormones, particularly cortisol, which bind to immune system cells and alter their functions. Stress activation of sympathetic nervous system fibers that connect to immune system tissues also alters immune functioning.

Unhealthy Behaviors

Stress can contribute to ill health by fostering unhealthy behaviors. To manage stressful feelings, some people smoke cigarettes, overeat, undereat, overwork, or drink alcohol and use other drugs. Among U.S. college students, for example, overconsumption of alcohol is often employed to reduce stressful feelings (Conn, Ejesi, & Foster, 2017). Furthermore, people with high levels of stress may not

engage in health-promoting activities, such as exercising regularly, eating properly, or getting enough sleep.

Posttraumatic Stress Disorder

Some forms of stress are so severe that they produce a serious, long-lasting condition called *posttraumatic stress disorder*. This condition can result from witnessing or being confronted with events that involve death or serious injury or a threat to the physical or psychological integrity of oneself or others. In such traumatic situations, the person experiences intense fear, helplessness, or horror. Common sources of PTSD are combat in war and sexual assault. Other sources of PTSD are living through a natural disaster, experiencing a severe car or plane crash, physical assault, repeated psychological abuse, severe childhood maltreatment, and life-threatening illnesses. Adults who as children experienced repeated caretaker abuse and neglect have been shown to be at high risk for cardiovascular disease, cancers, asthma, and depression as a result of damage to the brain structure from cortisol and neuroinflammation (Deighton, Neville, Pusch, & Dobson, 2018).



Several heart attacks occur every year on the floor of the New York Stock Exchange, making it one of the highest-density heart attack zones in the United States. The exchange has installed a defibrillator near the bank of phones used to place orders for stock trading, and it has trained workers to use the defibrillator and perform CPR when a heart attack occurs.

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Some of the diagnostic criteria for PTSD include (1) flashbacks to traumatizing events or recurrent unbidden thoughts and dreams of the experience; (2) persistent avoidance of cues that symbolize the traumatizing event(s); (3) difficulty sleeping, outbursts of anger, and being hyperalert and easily startled; and (4) having little interest in daily activities, feeling cut off from others, and a sense of having a limited future.

How the traumatic stress of combat, natural disasters, and physical and sexual assault produces the symptoms of PTSD is not fully understood. Because not everyone exposed to a traumatic situation develops PTSD, researchers suspect that some people are

more susceptible, perhaps because of some aspect of temperament, prior stressful experiences, or a history of anxiety or depression. Treatment of PTSD includes psychological therapy and one of a variety of drugs that stabilize mood.





Taking time to relax helps eliminate stress.

© Lorena Fernandez/Shutterstock



Climate Change Stress

Got worries? One of the lessons humans learned or should have learned from the COVID-19 pandemic is that Nature operates by certain rules that are more powerful than human desires. Given the appropriate circumstances and the lack of strong defensive measures, the sudden international propagation of a fatal viral infection could be as inevitable as a sunrise.

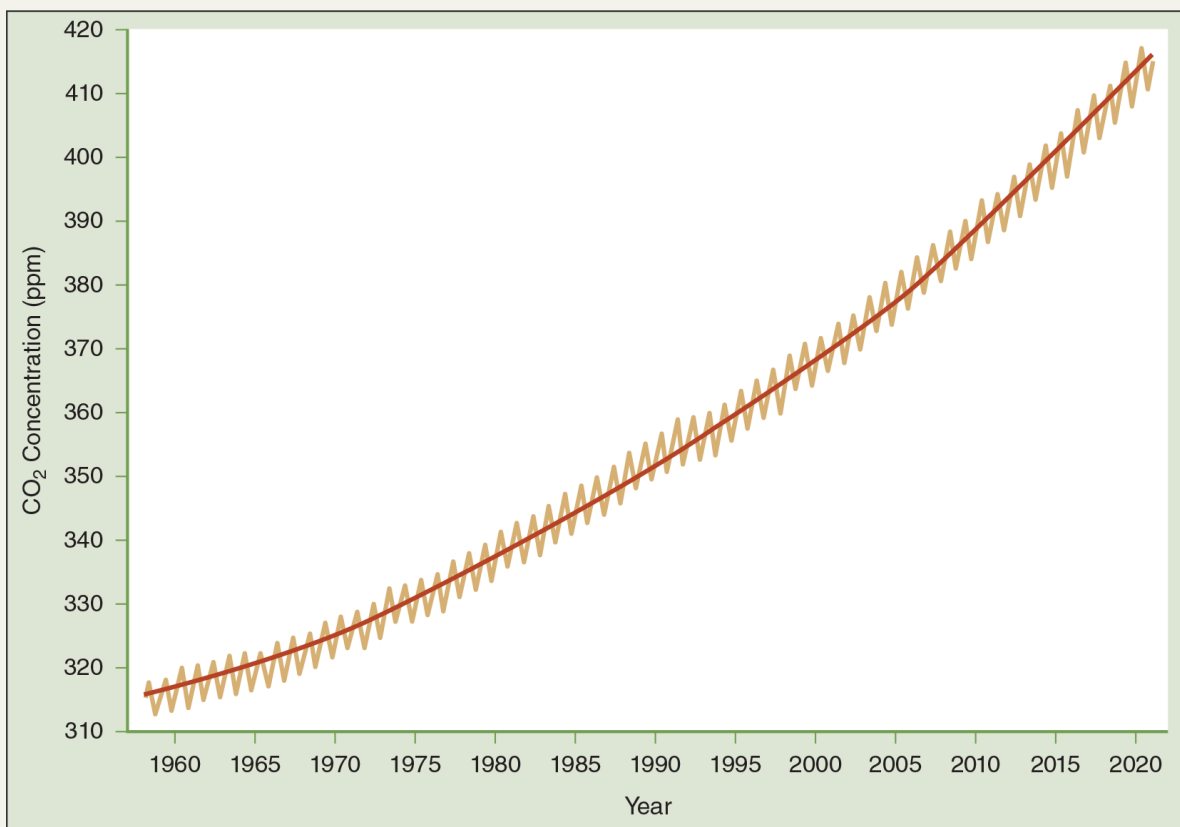
Besides the possibility of another pandemic sometime in the foreseeable future, people may also be anxious about the not-so-welcome effects of climate change (Taylor, 2020), already making its marks and surely to make more in the upcoming decades (Intergovernmental Panel on Climate Change, 2020). Psychologists and scholars refer to this as *climate stress*, *climate anxiety*, or *eco-anxiety* (Panu, 2020). Climate stress or climate anxiety has the basic elements of psychological stress—uncertainty, unpredictability, uncontrollability—and in some people, feelings of overwhelm, frustration, and guilt for continuing to use fossil fuels even as they know they are exacerbating the problem. Unlike clinical anxiety in which avoidance of an imagined threat is a central coping mechanism, climate change stress is an activating emotional reaction to an actual threat (Wu, Snell, & Samji, 2020). Instead of helpless and hopeless, climate stress fosters being optimistic about success in the fight against climate change, as evidenced by the activism of Greta Thunberg and the millions of young people around the world who in 2019 demanded action of world leaders to combat climate change.

In 1960, from measurements he'd been making for about a decade, Professor Charles David Keeling at the University of California, San Diego's Scripps Institution of Oceanography, reported that the level of atmospheric carbon dioxide was gradually increasing. Sixty years later, the trend noted by Dr. Keeling continues (see the accompanying Keeling curve figure). By the 1990s, it was scientifically evident that Dr. Keeling's findings were the result of the burning of fossil fuels to power human civilizations and the associated heat-trapping properties of atmospheric carbon dioxide.

By the end of the 20th century, world leaders, surely responding to their own climate change stress, began to focus attention on limiting (if not eliminating) fossil fuel emissions in order to stave off a predictable—and probably devastating—change in Earth’s climate. In 2015, 196 countries of the world came together in Paris, France, to enter a legally binding international treaty (“The Paris Agreement”) to reduce global greenhouse gas emissions and restrain global warming to 1.5 degrees Celsius compared to preindustrial levels (United Nations, 2020).

The good news is that climate change stress is motivating governments, non-governmental organizations, businesses, and groups and individual citizens to act in their own defense by establishing zero-carbon emission targets (Rowlatt, 2021). The signers of the Paris Agreement promised to meet every 5 years to commit to plans for achieving the agreement’s original goals, such as completely phasing out the burning of coal as a source of energy and to end all financial subsidies of all fossil fuels by 2050.

As of 2020, the Yale University Climate Opinion Map (2020) indicated that 63% of Americans are worried about global warming and that same percentage believes they and other citizens should do more to address global warming. Perhaps this is a sign of climate change anxiety in action.



The Keeling Curve. Monthly Average Atmospheric Carbon Dioxide Concentration and Fossil Fuel Emissions, 1956–2021.

Black curve: Monthly average atmospheric carbon dioxide concentration versus time at Mauna Loa Observatory, Hawaii (20 °N, 156 °W), where CO₂ concentration is in parts

per million (ppm) in the mole fraction.

Red curve: Fossil fuel trend of a fixed fraction (57%) of the cumulative industrial emissions of CO₂ from fossil fuel combustion and cement production. This fraction was calculated from a least squares fit of the fossil fuel trend to the observation record.

C. D. Keeling, S. C. Piper, R. B. Bacastow, M. Wahlen, T. P. Whorf, M. Heimann, and H. A. Meijer, Exchanges of atmospheric CO₂ and ¹³CO₂ with the terrestrial biosphere and oceans from 1978 to 2000. I. Global aspects, SIO Reference Series, No. 01-06, Scripps Institution of Oceanography, San Diego, 88 pages, 2001.

Description

Managing Stress

The best ways to manage stress are to replace stressful ways of living with beliefs, attitudes, and behaviors that promote peace, joy, and mind–body harmony. That does not mean you must become reclusive or try to eliminate all sources of difficulty and tension in your life. People need challenges to be creative and grow psychologically and spiritually. It may mean, however, changing some self-harming ways of thinking and behaving.

Living healthfully is fundamental to limiting stress. By eating properly; stretching and exercising regularly; getting sufficient sleep; not smoking cigarettes; limiting caffeine, alcohol, and other drugs; and taking “quiet time” to be contemplative, creative, and joyful, you establish a strength of mind–body–spirit that can help buffer the twists, turns, and pulls of stress. When especially busy, it’s tempting to put off taking care of oneself: “There isn’t time; I’ll do it later.” If you must put self-care off, schedule a time for healthful living as you do a class or other regular activity.

Besides living healthfully, managing stress also involves **coping**, which refers to efforts to manage a stressful situation regardless of whether those efforts are successful. In general, there are three types of coping processes (Folkman, Lazarus, Dunkel-Schetter, DeLongis, & Gruen, 986): problem-focused coping, emotion-focused coping, and denial, distancing, or giving up.

Problem-Focused Coping

The stressful situation is appraised as changeable and a plan for improving things is devised and attempted. The key feature of **problem-focused coping** is the belief that one can change things for the better (optimism). Even if it turns out that change is not possible, believing it to be so lessens stress. Believing that one cannot change a *changeable* situation for the better (pessimism)

creates a sense of helplessness and hopelessness, which can lead to giving up and depression.

Some ways to practice problem-focused coping include the following:

- Limit or eliminate interaction with the stressor. Be assertive with an annoying roommate, say “no” to unreasonable requests, use earplugs to block out noise, change jobs, or change your major.
- Alter your perception of a stressful situation (called *cognitive reappraisal*). By perceiving a situation as less challenging, you lessen the chance of feeling overwhelmed. Ask yourself, “Am I seeing this situation realistically? And even if I am, is it really that threatening?”
- Set attainable goals. Winning may be an athlete’s highest goal, but worrying about losing can make one sick. The solution is not to give up sports but to change priorities, perhaps by emphasizing the joy of participation rather than the outcome of competition.
- Focus on your personal strengths, values, and positive qualities. Have confidence in your ability to lessen stress. Give yourself credit for things you have done to lessen stress rather than believing that it was blind luck. This enhances the belief and confidence that you can master many situations that you encounter. Remember that stress is a function of one’s belief about managing a challenging situation.
- Seek social support. Talk to friends, family members, counselors, or teachers—anyone who you believe can understand, lend a sympathetic ear, and offer sound feedback

and advice if you request it. Remember: A problem shared is a problem halved.

- Reduce physical tension. Take a walk, ride a bike, jog, or do yoga, progressive muscle relaxation, or t'ai chi—any physical activity that can release muscle tension and focus your mind on something other than your problems.
- Keep your sense of humor. Laughter and joy are beneficial to the spirit and immune system (Zander-Schellenberg et al., 2020).
- Engage in sensory experiences such as art, music, or a walk in a garden, through the woods, or along the beach or lake shore (Soga & Gaston, 2020).

Emotion-Focused Coping

The stressful situation is appraised as not immediately changeable, and one decides to accept and work with the reality of the situation, perhaps by waiting for an opportunity to take action or by looking for the good in the bad (“a learning experience”). To facilitate acceptance, one might seek solace and comfort in religion, social contact, being with Nature, or perhaps becoming more involved in helping others.

Some ways to practice **emotion-focused coping** include the following:

- Ease your mind. Employ any of a variety of methods that can stop the physiological stress response and produce instead the “relaxation response.” These include mindfulness, yoga, exercise, image visualization, guided imagery, journal writing, and prayer. Making one of these methods work for you requires practice and persistence. After learning about the methods,

choose one to experiment with almost daily over the course of a week. When you find one or two that you like, make doing them a regular part of your life.

- Let go. Even if only for a few minutes, stop carrying problems in your mind. Give yourself a break from stress by “leaving it at the river” (see the Managing Stress feature “Two Monks and the River”).

Denial, Distancing, and Giving Up

When the stressful situation is appraised as not amenable to change, rather than accepting that reality, one chooses not to think about it (denial), to undertake escapist activities (oversleeping, overeating, using drugs and alcohol, or increased TV watching, Web surfing, and video game playing), or to become fatalistic and helpless (give up).

In general, problem-focused coping is best for dealing with practical problems and situations that can be resisted or overcome with one's personal efforts. Emotion-focused coping is best for dealing with situations not amenable to change but which must be faced such as the death of a loved one, illness, or coping with a natural disaster. Denial and avoidance tend to be ineffective coping strategies.

College Student Stress

Being in college can be both rewarding and intense. In college you get the opportunity to learn a variety of interesting things, meet new people, prepare yourself for a rewarding job or career, become an honorable person and good citizen, and identify your values, abilities, and preferences. On the other hand, college life has the potential to be stressful ([Table 3.2](#)). Students are challenged daily to perform academic tasks, some of which are new (that's why it's called *learning*) and thus raise doubts about oneself and one's abilities. The college experience is rife with change and unfamiliarity: new classes, new teachers, new people, new living situations. Because college is not home and the people are not family, there may be little support. To top it off, rather than getting paid for all their hard work, students do the paying. Furthermore, when younger college students are first on their own, they may not always make the wisest, safest, and healthiest choices.

TABLE 3.2 **Examples of College Student Stressors**

<i>Academic</i>	Competition Schoolwork (difficult, low motivation) Exams and grades Poor resources (library, computers) Oral presentations and public speaking Professors and coaches (unfair, demanding, unavailable) Choosing and registering for classes Choosing a major or career
<i>Time</i>	Deadlines Procrastination Waiting for appointments and in lines No time to exercise Late for appointments or class
<i>Environment</i>	Others' behavior (rude, inconsiderate, sexist or racist)

	Injustice: seeing examples or being a victim of Crowds or large social groups Fears of violence/terrorism Weather (snow, heat or humidity, storms) Noise Lack of privacy
<i>Social</i>	Loneliness Obligations, annoyances (family, friends, girlfriend, or boyfriend) Not dating Roommate or housemate problems Concerns about sexually transmitted diseases (STDs) or unintended pregnancy
<i>Self</i>	Behavior (habits, temper) Appearance (unattractive features, grooming) Ill health or physical symptoms Forgetting, misplacing, or losing things Weight and dietary management Substance abuse Self-confidence and self-esteem Boredom
<i>Money</i>	Not enough Bills or overspending Job: searching for interviews and being interviewed Job and work issues (demanding, annoying)
<i>Tasks of Daily Living</i>	Tedious chores (shopping, cleaning) Traffic and parking problems Car problems (breaking down, repairs) Housing (finding or getting or moving) Food (unappealing or unhealthful meals)

A healthy lifestyle—eating properly, exercising regularly, getting sufficient restful sleep, having daily quiet time and regular creative relaxation (reading, socializing, art, enjoying or making music)—is fundamental to dealing with college stress. Unfortunately, with so many demands and time pressures, it is tempting to put off choices for living healthfully.

Overload

If they were to occur sequentially, individual stressors in college such as taking a test, going through a rough time with a romantic partner, or moving to a new residence, although unpleasant, would be generally manageable. However, in college, many challenges and changes occur virtually simultaneously. For example, at the end of a semester, a student could face having to write two final papers, take five finals, deal with a bad cold, and move to a new apartment. And the next semester, there would likely be a new set of challenges (an ill parent, a course that makes no sense) along with some of the usual ones (final papers and exams and problematic social relationships).

Being confronted with too many challenges and changes can lead to **overload**—the feeling that there are too many demands on your time and energy. Your life consists of zipping from here to there to attend to all of your tasks, but what you really want is a week off to hang with your friends and veg out. And if overload grows to feeling overwhelmed, a student might drop a class or two, drop out of school, get depressed, or use alcohol or drugs.

At the heart of overload is the sense of lacking personal control. Individuals who believe they can influence the course of their lives (internal locus of control) are likely to experience less stress than individuals who believe that their fate is determined by factors outside of their control (external locus of control) (Au, 2015). Thus, although it is tempting to focus on things outside of yourself to explain feelings of overload and being overwhelmed, it is more productive to look at yourself. This is good because you have more control over yourself than you do over things in your environment.

Here are some antidotes to overload:

1. *Plan ahead.* Knowing when a stressful situation will occur produces less stress than not knowing does. For example, most of the time, you will know at the beginning of a semester when major assignments are due. Plan for them.
2. *Keep a to-do list.* At the beginning of each day, or the night before, write down and prioritize all the things you have to do.

3. *Clarify intentions.* Before you begin each day, take a few moments to be quiet and still and clarify your intentions. Ask yourself, “What do I want and need to make happen today?” “What do I need to do to keep my mind, body, and spirit healthy and well?” Don’t think only of accomplishing tasks but also the effects your behaviors will have on yourself and others.
4. *Prioritize tasks.* First things first. Classify tasks according to their urgency and importance (**Figure 3.6**) and do them in this order: (1) urgent and important, (2) not urgent but important, (3) urgent but not important, and (4) neither urgent nor important. Distinguishing the urgent and important tasks from the urgent and not important ones is often difficult because urgency is a state of mind and makes everything seem important. Before prioritizing items on your to-do list, take a few minutes to become mentally and physically quiet. This will allow you to place truly urgent and important items at the top of your to-do list.

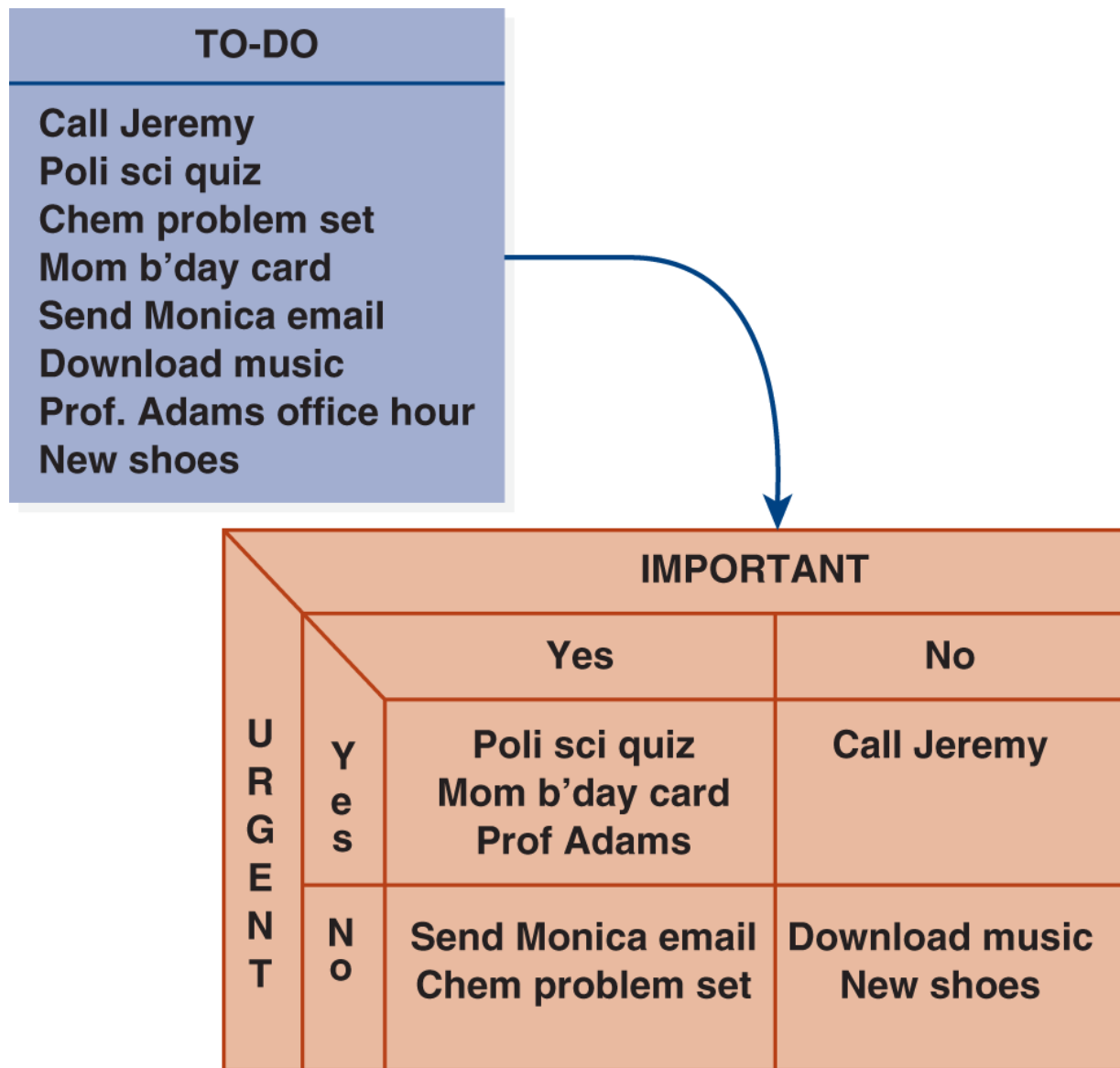


Figure 3.6 Prioritizing Tasks. Classify tasks from your to-do list according to their urgency and importance and do them in this order: (1) urgent and important, (2) not urgent and important, (3) urgent but not important, and (4) neither urgent nor important. Move tasks labeled “urgent and not important” to other categories because urgency is a state of mind and makes things seem important even if they are not.

Description



Academic pressures and test taking can produce anxiety and stress.

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5. *Don't sweat the small stuff.* Eliminate unimportant tasks from your list. Don't do, think about, or worry about anything that doesn't match your most important values and long-term goals. "Keep your eyes on the prize."
6. *Schedule downtime.* Even if it's only a few moments a day, take time for activities that you find meaningful and fun or just chill.
7. *Sleep.* Not sleeping enough reduces performance and efficiency on tasks by as much as 50%, which makes tasks take longer and contributes to the sense of overload.
8. *Don't "Just do it."* "Just Do It" is a slogan for selling sports shoes, not living a life. Students often erroneously believe that the solution to overload is to put in more effort ("just do it"). Because they already are maxed out, putting in more effort cannot succeed, although a list of undone tasks can contribute to a loss of

confidence and self-esteem, anxiety, and wear and tear on the body.



Two Monks and the River

Two monks set out on their last day's journey to their monastery. At midmorning they came upon a shallow river, and on the bank stood a beautiful young maiden.

"May I help you cross?" asked the first monk.

"Why, yes, that would be most kind of you," replied the maiden.

So the first monk hoisted the maiden on his back and carried her across the river. They bowed and went their separate ways.

After an hour or two of walking, the second monk said to the first monk, "I can't believe you did that! I just can't believe it! We take vows of chastity, and you touched a woman. You even asked her! What are we going to tell the abbot when we get home? He's going to ask how our journey was, and we can't lie. What are we going to say?"

Another couple of hours passed and the second monk erupted again. "How could you do that? She didn't even ask. You offered! The abbot's going to be incredibly angry."

By late afternoon the two were nearing their home, and the second monk, now filled with anxiety, said, "I can't believe you did that! You touched a woman. You even carried her on your back. What are we going to tell the abbot?"

The first monk stopped, looked at the second monk and said, "Listen, it's true that I carried that maiden across the river. But I left her at the river bank hours ago. You've been carrying her all day."

Time Management

A major cause of college student stress is the sense that there's too much to do and not enough time to do it. Because you can't make more time, the way to ease this pressure is to make the best use of the time you have. The following are tips for time management.

- *Perform a time audit.* For at least three representative days in your week (a whole week is better), write down everything you do during each of the 24 hours. Make a chart (**Table 3.3**). Identify windows of time that could be put to better use and alter your activities accordingly.

TABLE 3.3 Time Audit	
Time Diary	
Time	Activity
6:00 AM	Wake up
6:15 AM	Shower, dress, eat
7:00 AM	Go to school
8:00 AM	Chem lecture
9:30 AM	Hang out in library, snack
10:30 AM	Psych lecture
12:00 AM	Work
5:00 PM	Go home

Time Diary

Time	Activity
------	----------

Directions: Record your activities for three representative days. Enter data two to three times a day. For example, at noon, record your activities since awakening; at 5:00 PM, record your activities since noon; at bedtime, record your activities since 5:00 PM. Calculate the average daily hours awake, asleep, at school, studying and doing schoolwork, at work, with family, with friends, with self, commuting, and other.

- *Be energy efficient.* Schedule important activities for the times of the day when you are most alert and attentive. For example, if you're a morning person, take morning classes and study in between them. Schedule exercise and socializing for the afternoon. Night people might do the opposite.
- *Resist multitasking.* Try to do only one thing at a time. Multitasking appears to be time efficient, but it also creates a sense of urgency, which produces anxiety and stimulates the secretion of stress hormones, thus contributing to stress and decreased performance.
- *Control interruptions.* Discourage drop-in visiting; don't answer texts, the phone, or instant messages (if it's important, the person will try again); stay away from TV, computer games, and the Internet. Put away or turn off your phone.
- *Tame any tendencies toward perfectionism.* Don't waste time trying to make everything perfect. Every task has a point of diminishing returns—when the time and energy you put in is out of proportion to what you can reasonably hope to get back.
- *Understand any tendencies to procrastinate.* Procrastination often grows out of the fear of failure or exposure (the imaginary

situation of people seeing you or your work and judging it harshly). When you hear a voice in your mind spewing a litany of excuses for not working at a task, ask yourself what you fear. Be your own best friend by acknowledging the fear of failure and criticism but also suggest that the fear is costing you a chance to accomplish something and is probably exaggerated (see Chapter 17 Wellness Guide, “Be Your Own Best Friend”). Encourage yourself to move ahead. Rather than focus on the end product of your efforts, do *one thing* that will move you ahead. If you have not begun to study for an upcoming exam, don’t think about the exam. Instead, promise yourself that you will take your textbook out of your backpack today. That’s all. Tomorrow, promise yourself you will open it. Remember, “The journey of a thousand miles starts with a single step.”

Test Anxiety

It is a rare college student who does not get nervous when taking tests. People in American society equate educational success, academic degrees, and professional licenses with the attainment of important life goals, particularly financial ones. As a consequence, competition among students at all levels is intense. Students believe that grades and exam scores will determine how successful their lives will be in terms of jobs, careers, status, and money.

Many students experience health problems because of academic pressures and anxiety about exams. They may suffer from headaches, stomach and bowel problems, disordered eating, recurrent infections, substance use, and other symptoms of stress. Students whose exam anxiety affects their health will benefit from making adjustments to reduce the anxiety while they pursue their goals.

Test anxiety is a sense of unease and apprehension—frequently accompanied by physiological symptoms such as upset stomach, restlessness, sleep problems, irritability, and “nervous” eating—that precedes the taking of an exam. Besides creating physical illness, test anxiety can make it difficult to focus and concentrate during a test, increasing the likelihood of forgetting (blocking) and making “careless” errors.

Test anxiety is a form of performance anxiety, which can occur in any activity in which someone cares about the outcome of her or his performance. (If the person didn’t care about the outcome, then he or she would not be nervous about it.) Students, athletes, musicians, actors, and people who interview for jobs are all familiar with performance anxiety.

Being somewhat nervous about how well you are going to do leads to performing well. Unfortunately, being too nervous reduces performance on the task (**Figure 3.7**). With regard to tests, being a little nervous can motivate you to study prior to the test and to focus your attention while taking the test. Being too nervous prior to the test can lead to procrastination and during the test can distract your attention and focus from the test.

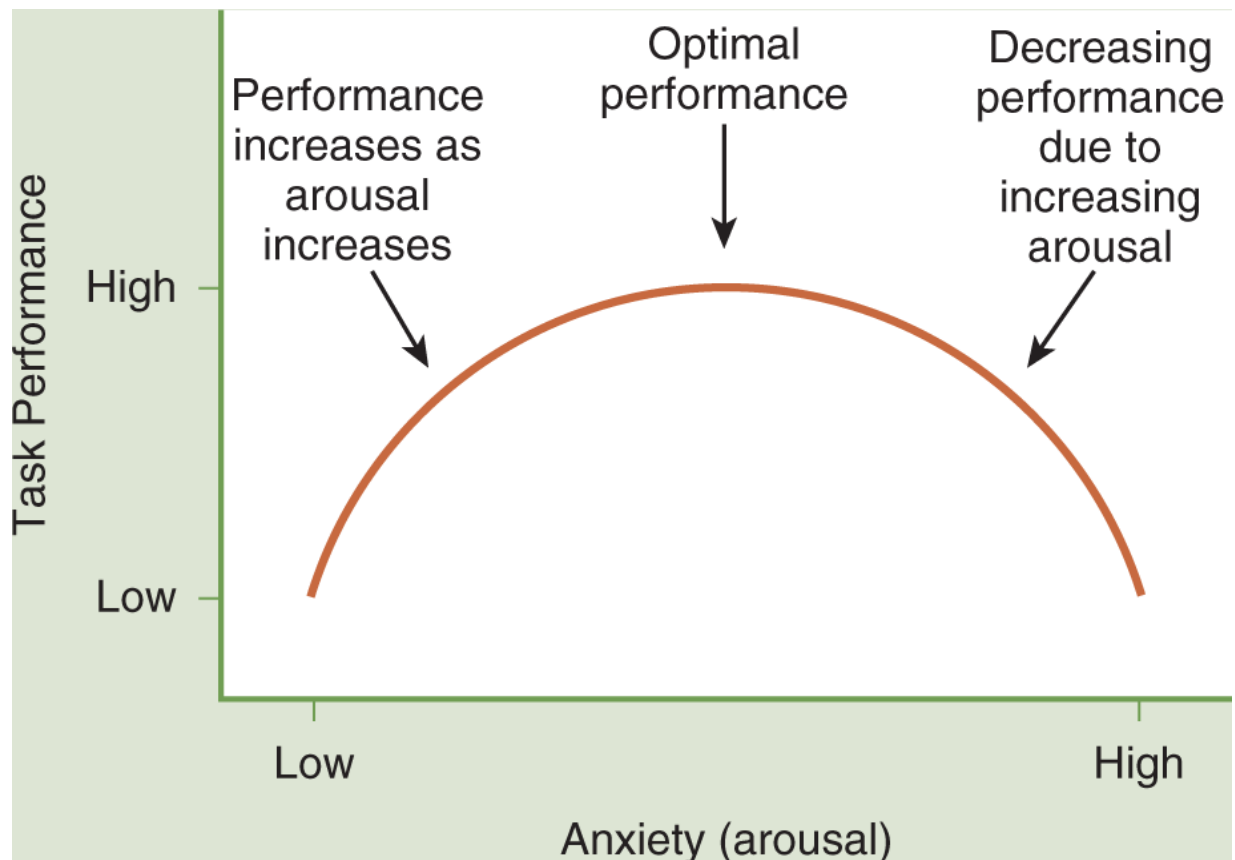


Figure 3.7 Performance Is Affected by Anxiety and Arousal. This graph shows what is known as the *Yerkes-Dodson Law*, named after the two psychologists who developed it. It shows that performance on a task is affected by how anxious a person is about how well she or he is going to do. Being somewhat anxious leads to better performance until an optimum level of performance is reached. Being too anxious distracts the mind and reduces performance.

Description

Whenever you are performing a task (and care about the outcome), your goal is to be just nervous enough to be at peak performance but not so nervous that you panic and lose focus. The only way to know where this peak is for you is by experience. This is why, after having taken dozens of tests, students become expert test takers. And this is why during the first couple of years of college, many students are petrified of tests.

Test anxiety is heightened by a test taker's internal mental messages, or self-talk, which focus on imaginary "terrible" outcomes

of doing poorly on the exam. Examples include the following:

- *Exaggerating the importance of the test:* “If I do poorly on this test, I’ll do poorly in the class. If I do poorly in the class, I won’t get into law school. If I don’t get into law school, I’ll be a failure and die of shame.”
- *Fear of autonomy and exposure:* “If I do well, everyone will notice me and I will be embarrassed.”
- *Fear of abandonment:* “If I do poorly (or well), my friends and family will reject me.”
- *Confusing one’s performance on an exam with one’s self-worth:* “If I do poorly (or good) on the exam, it will prove that I’m a loser.”

Solutions to Text Anxiety

Acknowledge that you get nervous before tests and try to become aware of the roots of your test anxiety. Keep a journal of pretest feelings and symptoms. Be attentive for the images and negative messages in your internal self-talk. If you tell yourself, “You’re not smart enough to do well,” perhaps respond by saying to yourself, “There goes Mr. Negative again. I know I can do this.” Remember: If you don’t prepare adequately for the exam by studying, and you care about your performance, then it’s realistic to feel anxious about the possibility of doing poorly.



Visualization Reduces Exam Anxiety

The following exercise can reduce the stress and anxiety of taking exams. It can result in improved scores and a reduction in symptoms produced by stress.

1. Go to a comfortable place at time when you will not be disturbed by other people. Sit in a comfortable chair or lie down on a couch or floor. The main thing is to get physically comfortable. Listen to music if that helps you relax.
2. Close your eyes and ask your mind to recall a place and time where you felt contented. It might be a vacation, being with someone, or being alone in a beautiful, serene environment. Use your imagination and memory to reconstruct the scene where you felt happy and healthy. Notice that you had no concerns there at that time. Let yourself become involved with the scene. The process is similar to having a daydream or a fantasy. While your mind is focused on pleasurable memories, your body automatically relaxes.
3. When you feel quite relaxed, refocus your mind on the upcoming exam. See yourself taking the exam while feeling relaxed and confident. Because your mind and body are relaxed and comfortable, your mind automatically associates the same feelings with the image of taking the exam. Visualize the exam room, the other students, and yourself answering the questions; let your mind focus on as many details as possible.
4. Now project your mind into the future to the actual day and place of the exam. Notice how relaxed you feel as you take the exam; the anxiety you used to experience seems to have vanished. Continue with the visualization until you see yourself turning in the exam and feeling confident and pleased that you held it together.
5. Do this exercise each day for several days prior to any exam that causes anxiety. You will be surprised at the absence of nervousness and stress on exam day. You will be even more pleased at the improvement in your grades.

Here are some other suggestions for managing test anxiety:

- Realistically appraise the importance of an exam. Remind yourself that a test is only a test and not a measure of your self-worth or your future attainment.
- Remind yourself that focusing on the grade will distract you from learning the material.
- As part of test preparation, give yourself periods of quiet time in which to relax and visualize yourself taking the test (see the Health Tips feature “Visualization Reduces Exam Anxiety”). In your image, see yourself taking the exam confidently and masterfully. See yourself coming across a difficult question and

taking that experience in stride and moving on to another question that you can respond to with confidence.

- Focus your awareness on the test by getting your test-taking materials together before test time. Sharpen your pencils and get your Scantron or blue book and write your name on it. Arrive at the exam 5 to 10 minutes early and let yourself relax. Perhaps close your eyes, bring your shoulders down from your ears, let your hands go where they want to go, focus your attention on your feet touching the floor, and take a few calming breaths (inhale for a count of 4, hold for a count of 6, and exhale for a count of 7).
- Don't get into a frenzy before the test. Don't cram. That only increases anxiety. Set aside your notes and books and quiet your mind by focusing your attention on your breathing or your feet touching the floor.
- Get a good night's sleep. Eat a balanced meal (protein and complex carbohydrate; not sugary or fatty snacks) 1 or 2 hours before the exam.
- Once in the test situation, try to flow. If you block, *stop!* Put down your pencil, put your feet flat on the floor, close your eyes, and focus your awareness on your breathing. After 20 to 30 seconds, when you're ready, go back to the exam.
- Realize that test taking is a skill only partially related to how much one knows and understands. Like any skill, one improves with practice.

What You Can Do About Stress

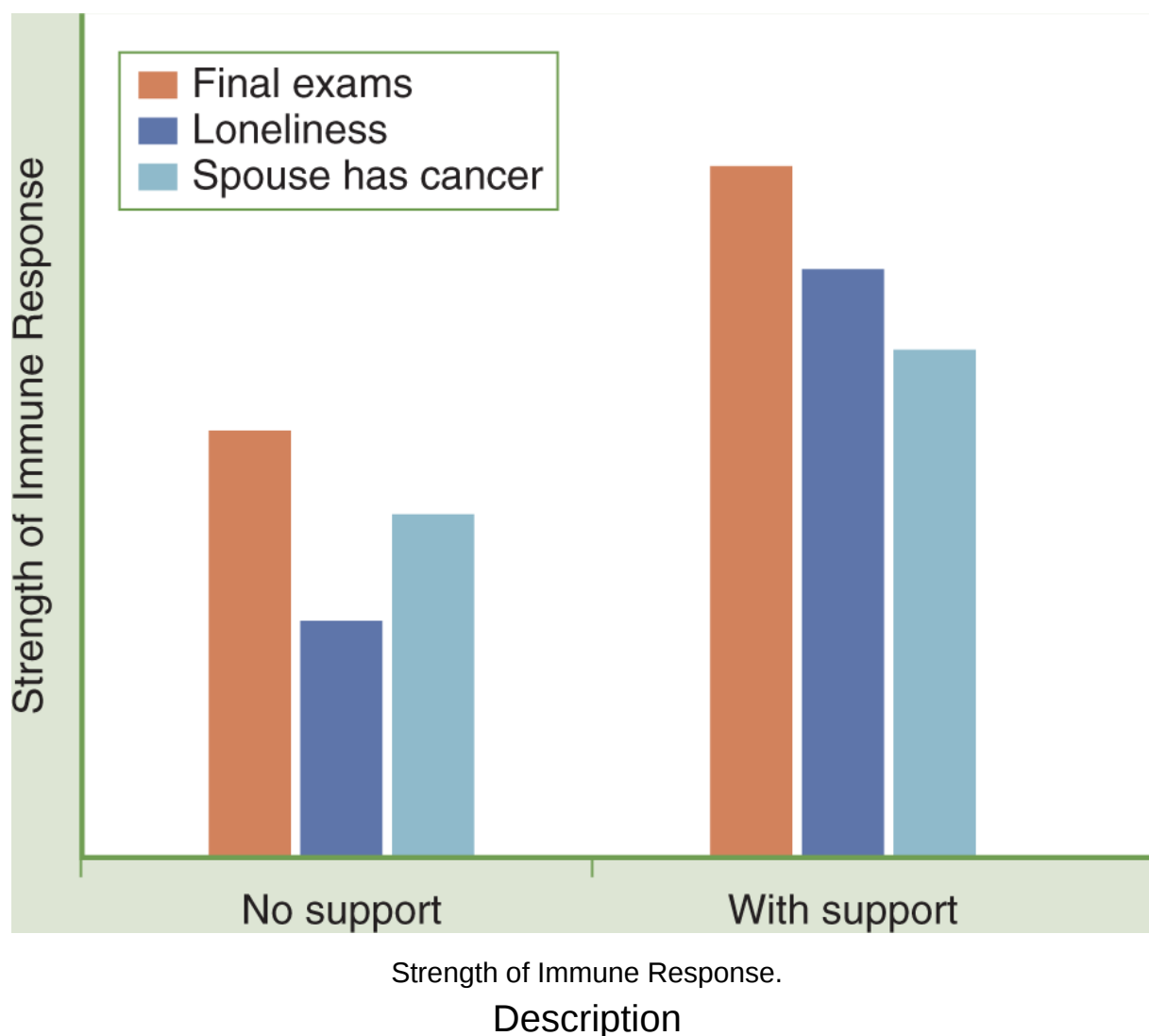
In the fast-paced, competitive world we live in, it's almost impossible not to experience stress and its many physiological and psychological manifestations. When stressed, we generally identify its causes as the hassles, obstacles, time pressures, unpleasantness in generally pleasant relationships, interactions with unpleasant others, and other situations that disrupt our feelings of mind–body harmony. What we often fail to recognize, however, is how we might be contributing to our stress by how we think about and respond to what we experience. It is not always possible to avoid or escape stressful situations. Neither is it generally possible to change others so that they behave in ways we desire. In the face of stress, a wise course is to become mindful of how your thoughts contribute to feeling stressed. Becoming increasingly aware of how your mind works can help you decrease the time your mind swirls around in the throes of stress.

Critical Thinking About Health

1. Three groups of people were vaccinated against a test substance (one that could not make anyone sick). Group 1 consisted of students during final exams; group 2, people complaining of loneliness; group 3, people whose spouse had cancer. Each group was further subdivided into two subgroups. One subgroup in each major group was given 6 weeks of weekly support group meetings plus education about reducing the stress of their circumstance. The other subgroup in each major group was given no support or education. The accompanying figure shows the results of the strength of the immune response to the test vaccine.
 - a. Explain the results of the experiment.
 - b. Suggest a hypothesis to explain the results of the experiment.
 - c. What do the results suggest about how you can better deal with stress in your life?
2. Johann Wolfgang von Goethe (1749–1832), the German author of *Faust* and other literary works, once wrote, “Things which matter most must never be at the mercy of things which matter least.”
 - a. What is your interpretation of Goethe’s idea?
 - b. How does letting things that matter most be at the mercy of things that matter least contribute to stress?
 - c. How susceptible are you to stress from letting things that matter most be at the mercy of things that matter least? What could you change to reduce that stress?
3. Offer an explanation for the following. In the 1980s, researchers studied the health of adults living in two communities that were separated by a river. North River was a prosperous suburb, and South River was an industrial region in which the major employer, an auto plant, had shut down. The research showed that after the auto plant closed, children living in South River had many more doctor visits for infections and allergies than did children in North

River. Also, adults in South River had more motor vehicle accidents and colds and flu during winter months than adults in North River did.

4. Do you experience test anxiety to such a degree that you become physically or emotionally upset before or after taking an exam? If so, describe your symptoms and feelings. If you're anxious about an exam coming up in the next few weeks, try the exercise described in the Health Tip box titled "Visualization Reduces Exam Anxiety" for at least a week before taking the exam. After the exam, describe your experience in detail and indicate whether you performed better than you expected on the exam.



CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Stress is an integral part of everyone's life. Stress occurs when something new is encountered, when you cannot perform a required task correctly, when you fail a test at school, or when a project does not turn out the way you want it to. Stress occurs when you are criticized, bullied, laughed at, or physically abused. On the one hand, stress plays an essential role in helping us learn, grow, and become more capable and confident. Stress is necessary for persons to learn how to handle difficult situations that are encountered throughout life. On the other hand, prolonged or excessive stress is physically and mentally destructive. Stress may lead to high blood pressure, digestive problems, overeating and obesity, sexual difficulties, and vulnerability to a variety of mental and physical illnesses.

In the absence of disrupting influences or excessive stress, the thousands of chemical reactions needed to maintain a healthy brain and body are automatically regulated by a process called *homeostasis*. The brain sends signals via the nervous and hormone systems to all the organs of the body to keep them functioning at precise, healthy levels. It is only when homeostasis goes awry as a result of stress or other disruptive factors that symptoms and sickness may occur. Maintaining mind–body harmony is another vital key to well-being. Things that affect mind–body harmony include relations with friends and family as well as being conscious of the environment you live in. Do you spend time gardening or hiking or just walking somewhere quiet and peaceful? These simple activities reduce stress, foster mind–body harmony, and help keep you healthy.

HIGHLIGHTS

- Stress is the disruption of mind–body harmony brought about by trauma, threats to life, or obstacles to carrying out daily tasks, accomplishing life goals, or achieving desired changes in life.
- Stressors are situations and circumstances that cause stress.
- The mental component of stress consists of the interpretation of a situation as threatening and the appraisal that one's personal resources are insufficient to meet the demands of dealing with the stressful situation.
- The physiological components of stress are the flight–fright–freeze response and activation of the hypothalamo–pituitary–adrenal axis, with consequent secretion of stress hormones, especially cortisol.
- Stress contributes to illness by wearing down the mind and body as described by the *general adaptation syndrome*, impairing immunity, and fostering unhealthy behaviors.
- Posttraumatic stress disorder is a serious medical condition resulting from exposure to traumatic events and near-death experiences.
- Stress can be reduced by disengaging from stressors or by altering perceptions and goals, thereby reducing the potential for stress-related illness.
- Stress can be reduced by techniques that produce a peaceful state of being, such as image visualization, meditation, exercise, yoga, and just taking it easy.
- College student stress includes overload, time pressures, and test anxiety.

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KEY TERMS

stress:

the sum of physical and emotional reactions to any stimulus that disturbs the harmony of body and mind

harm-and-loss situations:

stressful events that include death, loss of property, injury, and illness

threat situations:

events that cause stress because of a perception that harm or loss may occur

challenge situations:

positive events that may involve major life transitions and may cause stress

eustress:

stress resulting from pleasant stressors

distress:

stress resulting from unpleasant stressors

stressor:

any physical or psychological situation that produces stress

flight-fight-freeze response:

a defensive reaction that prepares the organism for conflict or escape by triggering hormonal, cardiovascular, metabolic, and other changes

hypothalamo-pituitary-adrenal (HPA) axis:

a coordinated physiological response to stress involving the hypothalamus of the brain and the pituitary and adrenal glands

posttraumatic stress disorder (PTSD):

physical and mental illnesses resulting from severe trauma

general adaptation syndrome (GAS):

a three-phase biological response to stress

coping:

efforts to manage a stressful situation regardless of whether those efforts are successful

problem-focused coping:

appraising a stressful situation as changeable and making and attempting a plan for changing something to improve things

emotion-focused coping:

appraising and accepting a stressful situation as not immediately changeable and adopting an attitude that lessens anxiety and brings comfort

overload:

the feeling that there are too many demands on one's time and energy from being confronted with too many challenges



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CHAPTER 4

Mental Health



Health Tips

Dealing with Procrastination

Strategies for Managing Ongoing Anxiety



Global Wellness

Depression Is Worldwide



Managing Stress

If a Friend Is Considering Suicide



Wellness Guide

Developing Coping Strategies

Navigating Your Anger

Self-Care: Self-Compassion for Academic Success and Lifelong Well-Being

Progressive Muscle Relaxation

LEARNING OBJECTIVES

1. List the three components of mental health.
2. Define *mental illness*.
3. Describe the role of meeting basic human needs and mental health.
4. Describe the relationship among thoughts, emotions, and mental health.
5. List and describe strategies for coping with emotional distress.

6. List and describe four common anxiety disorders.
7. List five signs of depression.
8. Discuss the importance of sleep for well-being.
9. List and describe seven facets of sleep hygiene.

Many people think that good health is primarily related to proper nutrition and physical fitness. Although proper nutrition and exercise are important to health and well-being, so too are your mental and emotional health. When your thoughts, feelings, and behaviors are in harmony within yourself and you live harmoniously within your social and physical environments, you are more likely to feel good and be in good health than if you are chronically angry, frightened, tense, depressed, and at odds with your surroundings.

Forgiveness benefits the forgiver much more than the forgiven.

—**Vusi Mahlassela**, South African musician

The term *mental* refers to the totality of brain functions that produce thoughts, feelings, and intentional behaviors. As defined by the World Health Organization (2018), **mental health** is “a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community.” Just as with physical health, the World Health Organization considers mental health to reflect the totality of a person’s life and not solely the absence of a specific mental illness.

Mental and emotional health and well-being have three components (Centers for Disease Control and Prevention [CDC], 2021):

1. *Psychological well-being*, including self-acceptance, openness to new experiences, optimism, hopefulness, purpose in life,

spirituality, self-direction, positive relationships, and personal self-worth;

2. *Emotional well-being*, including joy, happiness, cheerfulness, contentment, and satisfaction with one's life; and
3. *Social well-being*, including believing that people are basically good, feeling socially accepted, belonging and being involved in a community, and believing that society can get better for all.

Mental illness refers to alterations in thinking, emotional regulation, or behaviors or disease processes that produce psychological distress or impaired personal or social functioning. Mental illness can result from brain damage, malnutrition, drug abuse, aging-related brain changes (e.g., Alzheimer's disease), and inherited or developmental anomalies that affect the brain. A mental illness is usually considered a medical problem amenable to medical treatment.

Much of a person's behavior is motivated by attempts to meet her or his basic needs (Gilbert, 2015), which include the following:

- *Protecting*: detecting threats to survival and applying strategies for defense and safety.
- *Attaining*: seeking and acquiring mental, emotional, and spiritual stimulation and accomplishment, self-esteem, and reproduction.
- *Connecting*: seeking contentment, emotionally rewarding interpersonal relationships, and kindness, safety, and soothing when upset or distressed.

Mental health is a function of how successfully one's basic human needs are met and how a person deals with circumstances in which one or more basic needs are not met, which is referred to as **coping** (see the Wellness Guide box "Developing Coping Strategies"). Infants have a limited need-fulfilling repertoire. They can cry when hungry or distressed and can smile or coo to invite touch and play. As individuals mature, they develop a more nuanced understanding

of their needs and develop a variety of strategies for interacting with their environment to meet them. When individuals succeed in meeting their basic needs, they experience pleasant emotions such as joy, pleasure, satisfaction, and contentment. When they do not, however, they experience unpleasant emotions such as frustration, anger, sadness, grief, and shame.



Developing Coping Strategies

Coping strategies are ways to deal with the emotional distress that comes from not having your needs met. In general, there are three coping strategies. You can alter (1) the interaction with the cause of the distress, (2) thoughts and beliefs regarding the significance of the need that is not being met, or (3) the distressing feeling without changing the situation or how you think about it.

To reduce emotional distress by changing your interaction with the situation, you could do any of the following:

- Attack the situation head-on (“I’m nervous about meeting new people, but I’ll go to the party anyway”).
- Avoid the situation (“I’m nervous they won’t like me. I’ll go some other time”).
- Adapt to the situation (“Even though I get nervous in social situations, that’s OK. So what?”).

To change your thoughts and beliefs about the significance of the unmet need, you could:

- judge your situation to be less distressing than someone else’s (“At least I’m meeting people. Poor John works so much he doesn’t get to meet anyone”);
- see your distress as necessary or temporary (“This is the way it is,” or “Eventually I’ll find somebody and I won’t have to go through this anymore”);
- focus on positive aspects of a situation and minimize the negative (“If I go, I’ll probably have a great time”);
- devalue the goal and believe you will do fine no matter the outcome (“If he says no, it won’t be the end of the world”).

Reducing emotional distress by changing or reducing the intensity of the feeling itself could involve releasing emotional energy through an alternative activity:

- Exercise helps with frustration and anger.
- Meditation helps with sadness and anger.
- Talking to a receptive and empathic person can help with grief, shame, and anxiety.

Mental health is built on mental processes that enable accurate appraisal of one's needs and aspects of the environment that can help meet them. This means perceiving and interpreting the world *realistically*—that is, how it actually is and not how we wish it to be—and having a biologically healthy brain and nervous system to coordinate and carry out appropriate responses, not a brain that is undernourished, diseased, or disequibrated with drugs or alcohol. The more a person's mental processes are in sync with the ways in which their social and physical environments work, the more likely they are to get their basic needs met.

Emotions are patterns of brain activity that can arise spontaneously or in response to what one experiences, has experienced, or believe may be experienced (**Figure 4.1**). Emotions generate a sense of pleasantness or unpleasantness, which helps a person evaluate an anticipated or actual experience and the outcome of a planned or an actual behavior. The subjective experiencing of an emotion is a *feeling*.

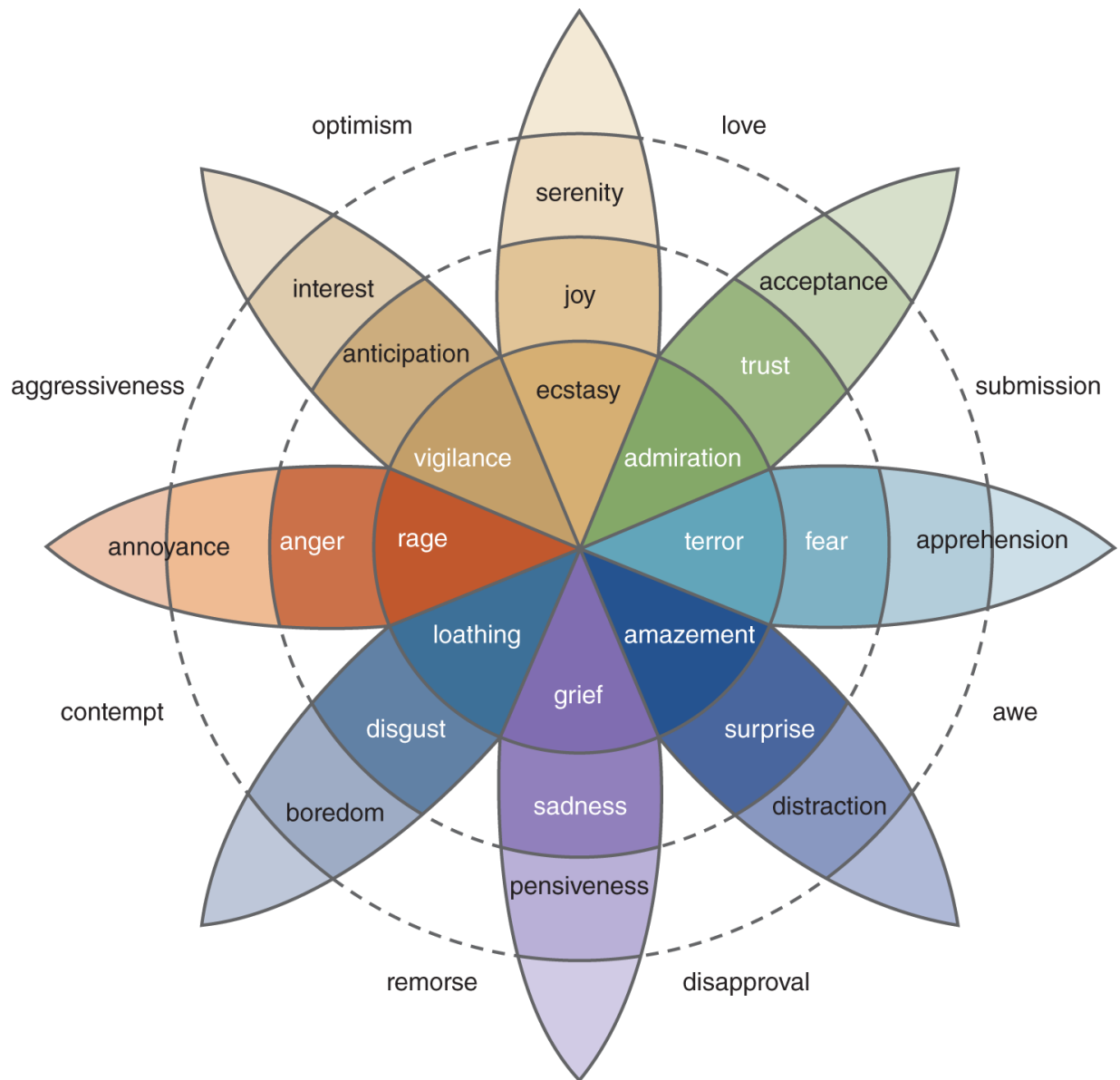


Figure 4.1 Basic Human Emotions. This image of the “emotion wheel” illustrates psychologist Robert Plutchik’s (1991) classification of human emotions into eight basic types, or primary emotions: anger, fear, sadness, disgust, surprise, anticipation, trust, and joy. Each basic emotion is represented by an arm on the emotion wheel. The three parts of each arm represent a basic emotion’s intensity—for example, joy intensifies to ecstasy. Plutchik proposed that the basic emotions are biologically based, having evolved to help human survival.

Robert Plutchik’s. Wikimediacommons <https://commons.wikimedia.org/wiki/File:Plutchik-wheel.svg>.

Description

Besides providing an evaluation of an experience, emotions provide the energy or motivation for behavior. In general, pleasant emotions (e.g., joy, interest, contentment, and love) motivate the pursuit of novel, creative, enjoyable activities, whereas unpleasant emotions (e.g., anger, fear, anxiety, disgust, guilt) can help one evaluate the outcome of a behavior or motivate avoidance or aversion to perceived threats to one's sense of well-being, physical safety, or survival.

In some scientific classifications, pleasant emotions are referred to as *positive* and unpleasant emotions as *negative*. It is important to recognize that these classifications refer to the feeling tone and not that the emotions themselves are good or bad. Even unpleasant emotions are beneficial when they signal that someone or something may be harmful and therefore should be avoided or subdued. In this way, unpleasant emotions are self-protective.



Navigating Your Anger

Anger occurs when we feel attacked, blamed, hurt, or have experienced a loss; when we *imagine* we've been attacked, blamed, hurt, or have experienced a loss; when we imagine we *may* be attacked, blamed, hurt, or experience a loss; or when the pursuit of an important goal is blocked (frustration). Sometimes we get angry because we perceive something as threatening that really isn't. In this case, we make ourselves angry by what we think. Anger is an excitatory emotion, providing the motivational energy to protect ourselves or things we care about or to overcome obstacles to our goals and to stop physical or psychological abuse and to protect ourselves from the hurt of loss.

One constructive way to work with anger is to examine and alter anger-generating thoughts. For example, to deal with frustration you can reassess the merits of the goal you cannot attain or reconsider the strategy you've employed for attaining it. It may feel right to blame someone else for your troubles, but a reevaluation of how you contribute to the situation may be more productive. It is far easier to change yourself than someone else.

Consider this example: Jill is supposed to meet Andrew so they can go to a concert together. Andrew looks at his watch and sees that Jill is 30 minutes late. Andrew thinks, "Jill's being rude," which gets him upset. Notice that Andrew has no idea why Jill is late; he is assuming that Jill is dissing him. By the time Jill shows up 10 minutes later, Andrew is boiling mad and refuses to talk to her.

Had Andrew thought differently about Jill's tardiness, he might have felt and behaved differently. Choosing to see a situation from a different point of view is called *cognitive reframing*. For example, using cognitive reframing, Andrew could have realized that his reaction to his fantasy about Jill's motive comes from *his* mind and not necessarily the real world. Having realized this, he could change his thought to something like, "I hope Jill isn't late because something bad happened to her," and his emotion upon seeing her might have been joy and relief that she was OK. He might even have hugged her.

The next time you feel angry, take a "time-out" for a few seconds, minutes, or days if necessary. Ask yourself what you've experienced that's led you to be angry. Are you really being harmed or threatened or are you making yourself angry because you've interpreted a situation as such?

To be mentally healthy, we do not have to be like everyone else. Being true to ourselves leads to greater satisfaction in life than social conformity does. Also, being mentally healthy does not mean that we never feel angry, anxious, lonely, depressed, confused, or overwhelmed. These are normal human emotions. Furthermore, being mentally healthy does not mean that we never need support, advice, or other kinds of help. In fact, inner strength is being able to recognize our limits and to seek and accept help so we can restore harmony when our mental and emotional resources are taxed.

A second touching a hot stove seems like an hour. An hour touching a pretty girl seems like a second. Now that's relativity.

—Albert Einstein

Facilitating Coping

Even when emotions make us aware that something in our lives is not going well, we do not always know what the problem is, what the best way to deal with it is, or how to overcome fear of change or longstanding inertia. People need not suffer in silence or believe themselves to be flawed or “crazy.” Support and advice are available from trusted family members, friends, teachers, clergy, and mental health professionals such as counselors, psychotherapists, and physicians. Reaching out to such people helps those in distress gain a new perspective on their problems and to see a workable solution.

Psychotherapists are professionals who have undergone considerable training to help people deal with their emotional distress. Whether a person has feelings of inferiority, is troubled by painful dependency in a love relationship, or is immobilized by fear, a psychotherapist can facilitate change that can make a person's life better. The change comes about not only by talking but also by helping the distressed person adopt new behaviors and attitudes. It is one thing to know intellectually the source of a personal problem and even what to do about it, but it may be quite another to face unpleasant emotions and adopt new behaviors (“the map is not the road”).

The value of psychotherapy, regardless of the method, is that the distressed person has faith in the professional's ability to facilitate change. This faith produces a situation of trust that enables the distressed person to be honest about himself or herself and to disclose painful and unflattering thoughts, memories, and emotions that would not likely be shared with a friend or relative.

Cognitive behavioral therapy (CBT) is a method for helping people in psychological distress by encouraging them to examine and change the thoughts that contribute to that distress. The method is based on the premise that erroneous beliefs about oneself and the world produce distressing emotions and maladaptive behaviors. Both

the distressing emotions and maladaptive behaviors produce symptoms, which clinicians diagnose as mental illness. For example, someone with a healthy body weight may erroneously believe that he or she is grossly overweight. This thought might lead to the development of an unhealthy eating disorder.

Often maladaptive beliefs are “automatic”—that is, they arise in particular situations independent of reason or logic and occasionally they are unconscious. Therapeutic strategies involve the patient and therapist working together to identify and challenge the validity of maladaptive beliefs and to replace them with more realistic ones. This leads to relief of emotional distress and reduction in problematic behaviors that arise from it. CBT is efficacious in treating anxiety disorders, sleep problems, somatic symptom disorders, bulimia, anger control problems, general stress, and depression. It is not uncommon for mindfulness training or self-compassion training to be integrated with CBT to enhance therapeutic efficacy.

Social Support Contributes to Health

Social support refers to the resources that one receives from others, particularly people in one's immediate social network with whom one has emotional bonds and social ties such as family, friends, schoolmates, coworkers, fellow church members, and professional helpers within one's community. There are several kinds of social support, including the following:

- *Emotional support* includes reassurance, acceptance, love, trust, and intimacy. When you feel cared for, accepted, and understood, you feel less alone, your self-esteem is enhanced, and you feel more confident and optimistic about managing your life. When you offer emotional support, you feel trustworthy and derive the pleasure and satisfaction of helping another.
- *Instrumental support* includes tangible help and material and financial assistance. Sometimes you need someone to take you to the doctor, bring you a meal, or loan you some money.
- *Informational support* includes specific information and knowledge of resources in the environment. Lack of information can block decision making, leading to ruminating and worry about your situation instead of acting.
- *Appraisal support* includes help with decision making. Sometimes you aren't sure what course of action to take, so you ask knowledgeable and trusted others for their opinions and advice.
- *Inclusional support* includes encouraging feelings of belonging to the community or a group and access to social contacts and

group activities. Belonging to groups alleviates loneliness and provides opportunities for fun, recreation, and the giving and receiving of help.

Numerous studies have shown that people with abundant social support live longer and more healthfully (Uchino et al., 2018). Social support contributes to health in several ways. First, social support encourages people to live healthfully. When you decide to exercise regularly, eat less junk food, or stop smoking, the encouragement, advice, and support from family and friends can help you stay on track with your plans. Also, when you are stressed or sick, social support can help you take care of yourself, including obtaining help from health professionals and following medical instructions. Second, social support can make you feel good. When others care about you, you feel good about yourself, you are more optimistic about accomplishing your goals, and you are less lonely, anxious, and depressed. All of these factors contribute to better health. Third, social support diminishes the body's stress responses and strengthens the immune system, thus lessening your risk of illness.

Fears, Phobias, and Anxiety

Fear is a powerful emotion that arises in situations that an individual interprets as dangerous. The purpose of fear is to alert a person to take protective action such as fight, flee, freeze, play dead, submit, or seek protection from others. In most cases, fear relies on the *thought* that something is dangerous. This means that sometimes fear can arise from actual threats and other times from misperceived or imaginary ones. For example, if you were hiking in the woods and encountered a large, hissing snake, you might naturally interpret this situation as dangerous, which would produce the emotion of fear, followed by a self-preserving behavior, like running away. If, however, you recognize (or are informed) that the snake is harmless, interpreting the situation as dangerous and becoming afraid would be needless. Notice how important thought and interpretation are in experiencing fear. This holds true for all emotions.



Dealing with Procrastination

When stuck in procrastination:

1. *Do not stress.* Have confidence that you can move yourself ahead.
2. *Remember:* The journey of a thousand miles begins with the first step.” Take *one step* toward your goal and congratulate yourself for doing so. If procrastinating about a school assignment, make Step 1 gathering resource materials. Set them out where you can access them easily.
3. Take Step 2: Organize your resource materials in a sensible way. This will kick-start your thinking about and making a plan for accomplishing your goal. Congratulate yourself for taking Step 2.
4. Step 3: Designate a time to begin working toward your goal. Write it in your day planner or add it to your calendar. Congratulate yourself. Take a break. Forge ahead when ready.

A **phobia** is an intense, often irrational, fear of, or aversion to, a specific object or situation. Although people with phobias generally know that their fear is out of proportion to the actual danger caused by the situation or object, they are nevertheless consumed by their fear and are compelled to engage in a safety behavior to avoid it. (More on phobias can be found at the Harvard Medical School, https://www.health.harvard.edu/a_to_z/phobia-a-to-z.)

If fear is a response to a situation interpreted as in-your-face threatening, **anxiety** is the response to an imagined situation, usually something in the future. The dictionary definition of anxiety is “a feeling of worry, nervousness, or unease, typically about an imminent event or something with an uncertain outcome.” As Thomas Jefferson wrote, “there are indeed . . . gloomy and hypochondriac minds . . . disgusted with the present, and despairing of the future; always counting that the worst will happen, because it may happen. How much pain they have cost us, the evils which have never happened” (Thomas Jefferson letter to John Adams, April 8, 1816).

There are two general patterns of anxiety: *intermittent* and *ongoing* or chronic. **Intermittent anxiety** generally lasts a week or two and is readily identified as a response to a specific upcoming event or situation. Intermittent anxiety usually goes away when the feared situation or event does. Most people consider intermittent anxiety a normal part of life. Although unpleasant, anxiety can help a person anticipate and prepare for life’s challenges—for example, an in-class presentation, an athletic or theatrical performance, or final exams. In some situations, some degree of anxiety can improve the outcome on a task because it can help focus attention and motivate preparation.

Ongoing anxiety tends to be physiologically and psychologically more intense than intermittent anxiety, and it can seem out of proportion, or even unrelated, to a specific situation. It can last for weeks, months, or years, intensifying over time, interfering with many parts of life, and impairing daily functioning and health. Each year, about 25 million North Americans experience anxiety severe enough for them to seek professional help from a counselor,

psychologist, or physician. Each year, about 25% of North American college students are treated for anxiety by a health professional (American College Health Association, 2020). There are several forms of ongoing anxiety (**Table 4.1**): social anxiety, obsessive–compulsive anxiety, generalized anxiety, panic disorder, and posttraumatic stress disorder (PTSD).

TABLE 4.1 Kinds of Anxiety	
Kind	Description
Social anxiety (social phobia) (medlineplus.gov/socialanxiety)	Persistent, intense, and chronic fear of being watched and judged by others and being embarrassed or humiliated by one’s own actions, an overwhelming and excessive self-consciousness in everyday social situations such as speaking in formal or informal situations, eating or drinking in front of others, or, in its most severe form, being around other people for any reason. Fear may be so severe that it interferes with work, school, and other ordinary activities. Accompanying physical symptoms include blushing, profuse sweating, trembling, nausea, and difficulty talking.

Kind	Description
<p>Panic disorder (https://medlineplus.gov/panicdisorder.html)</p>	<p>Unexpected and repeated episodes of intense fear accompanied by physical symptoms that may include chest pain, nausea, heart palpitations or pounding, shortness of breath, abdominal distress, and feeling sweaty, weak, faint, dizzy, flushed, or chilled. Feelings of terror may strike suddenly and repeatedly with no warning. The hands may tingle or feel numb. There may be smothering sensations, a sense of unreality, or fear of impending doom or loss of control.</p>
<p>Generalized anxiety (medlineplus.gov/ency/article/000917.htm)</p>	<p>Chronic anxiety and exaggerated worry and tension, even when there is little or nothing to provoke it. Anxiety is often accompanied by fatigue, headaches, muscle tension, muscle aches, difficulty swallowing, trembling, twitching, irritability, sweating, and hot flashes.</p>
<p>Obsessive–compulsive disorder (OCD) (medlineplus.gov/obsessivecompulsivedisorder.html)</p>	<p>Recurrent, unwanted thoughts (obsessions) or repetitive behaviors (compulsions) such as handwashing, counting, checking, or cleaning, often performed with the hope of preventing obsessive thoughts or making them go away. Performing these rituals provides only temporary relief, and not performing them markedly increases anxiety.</p>

Kind	Description
PTSD (medlineplus.gov/posttraumaticstressdisorder.html)	Persistent, frightening thoughts and memories of a prior traumatic experience in which grave physical harm occurred or was threatened and feeling emotionally numb, especially with people to whom one was once close. People with PTSD may experience sleep problems, feel detached or numb, or be easily startled.

Psychiatrist: Why are you waving our arms around like that?

Patient: To keep the wild tigers from attacking.

Psychiatrist: But there aren't any wild tigers in here.

Patient: See. It works!

No doubt about it, anxiety, whether intermittent or ongoing, feels yukky. You're distracted by worry, agitated, and restless. You don't sleep well. You don't feel like eating, and if you do eat it's too much of the wrong things. You feel lazy. Your muscles are stiff and achy. You're cranky and irritable. Because anxiety feels bad, it's reasonable that anxious people would be attracted to behaviors that distract them from feeling their anxiety, like eating their favorite ice cream or bingeing on anything, like texting, TV, junk food, drugs, or alcohol. Distracting oneself from feeling anxious but not doing anything to address the cause of the anxiety is called **avoidance**. A big downside to avoiding the warning in anxiety is that the issue has a chance to get worse and the anxiety get more intense over time. Also, the avoidant behavior could be harmful, like uncontrolled gambling, consuming too much alcohol or other drugs, or not going

to work or school. An unfortunate long-term outcome of avoidance is that it becomes a consuming habit in the face of all manner of life's challenges, making life less worthwhile ("avoidance gets you a void").

Rather than avoiding anxiety, psychologists recommend two cognitive behavioral therapy methods that are used either singly or together. One method focuses on identifying, challenging, and then neutralizing unhelpful or distorted thoughts underlying anxiety. The other method is called *exposure therapy*. It focuses on confronting fears and anxieties to help people engage in activities they have been avoiding. Each of these methods is often used with meditation, relaxation exercises, or imagery.



Strategies for Managing Ongoing Anxiety

1. Learn and practice mindfulness to train your brain to notice and let go of anxiety-producing thoughts when they arise.
2. Seek professional guidance to learn and practice different ways of thinking about and reacting to anxiety-causing situations before negative thought patterns and behaviors spiral. If anxiety is severe to overwhelming, a course of medication may be recommended at the start of counseling. Consider using an anxiety-management app that coaches helpful activities (e.g., Unwinding Anxiety, unwindinganxiety.com/; Headspace, headspace.com).
3. Keep your body and mind healthy by exercising regularly, eating healthfully, getting sufficient sleep, and staying connected to people who care about you. Avoid consuming excess caffeine (coffee, soft drinks) and nicotine (vaping, tobacco).
4. Keep a journal to practice identifying situations and challenging thoughts that trigger anxiety.
5. Anxiety can trigger self-isolation. Reach out to friends and family members who can help you cope in a positive way.

Depression

Depression is a condition of mind–body characterized by a severe reduction in the ability or willingness to engage life. Depression has been reported since ancient times in many cultures (see the Global Wellness box “Depression Is Worldwide”), manifesting as one or more of a variety of symptoms (**Table 4.2**). Most often, depression presents as a loss of interest in activities once enjoyed, a depressed mood (relentless feeling of deep sadness or melancholy), emptiness from feeling alone or uncared for, hopeless that a better experience is possible, and helpless to make things better. In some instances, depression is experienced as bodily complaints such as back pain, incapacitating fatigue, loss of appetite, and sleep problems. Depression can be extremely debilitating, and it can increase the risk of suicide.

TABLE 4.2 Common Symptoms of Depression

Psychological Symptoms	Behavioral Symptoms	Physical Symptoms
Depressed mood	Crying spells	Fatigue
Irritability	Interpersonal confrontation	Reduced or too much sleep
Anxiety or nervousness	Anger attacks, outbursts	Decreased or increased appetite
Reduced concentration	Avoidance of anxiety-provoking situations	Weight loss or gain
Lack of interest or motivation	Social withdrawal	Aches and pains

Psychological Symptoms	Behavioral Symptoms	Physical Symptoms
Inability to enjoy things	Workaholism	Muscle tension
Reduced interest in sex	Tobacco, alcohol, drug use or abuse	Heart palpitations
Hypersensitivity to criticism/rejection	Self-sacrifice or victimization	Burning or tingling sensations
Indecisiveness	Suicide attempts or gestures	
Pessimism, hopelessness		
Feelings of helplessness		
Preoccupation with oneself		
Thoughts of death or suicide		

In the course of their lifetime, about 17% of Americans experience at least one episode of major depression. Each year, about 13% of North Americans ages 18 to 25 experience depression. The prevalence of depression among North American college students is about 25% (American College Health Association, 2020). That depression is more prevalent among college students than their age peers is most likely the result of participating less in formerly pleasurable social activities because of school and other demands on time; a drop in grades, precipitating a loss of self-esteem and increased worry about being successful in the future; feeling overwhelmed, leading to an inability to concentrate on schoolwork; sleep disturbances (sleeping much more or less soundly than usual) not related to studying or cramming for tests; and consuming more alcohol than usual.

Often, a depressed student does not recognize that something is amiss. Instead, a parent, friend, roommate, teacher, or residence hall

advisor may notice depressive symptoms and encourage the student to seek help.

Depression can occur as a normal response to the loss of something that a person values or is attached to such as a loved one, a job, good health, or self-esteem (e.g., when a person does not succeed at a task she or he deems important). When individuals experience a loss, it is normal to feel sad and depressed and to grieve the loss. Sadness and grief are the human spirit's way to heal the hurt of loss and open the way for new attachments. When normal depression is associated with a loss, the depressed individual may be simultaneously aware that the experience is transitory and, along with grief, feel that there is hope for the future. This kind of depression tends to lift after the grieving ends.

In contrast to the depression that may be time-limited, some people experience **major depressive disorder**, a long-lasting depressive state or periodic episodes of deep depression that are not self-limiting and may hinder and even jeopardize their life. These depressions may be a response to stress, severe psychological trauma, injury, disease, biological malfunctions of some part of the brain, or a combination of factors. In some persons, major episodes of depression are accompanied by periods of excited euphoria (*mania*), resulting in a condition referred to as **bipolar disorder**.

Some individuals are susceptible to depression during the winter months because a lack of sunlight disturbs the production of neurotransmitters in the brain that affect mood. This **seasonal affective disorder (SAD)** is sometimes remedied by increased exposure to stronger-than-normal indoor lighting that mimics sunlight or relocation to southern latitudes where there is more wintertime daylight.



Depression Is Worldwide

Missing my dear mother, as a son,
my liver and intestines are painfully broken!
Crying for my old mother, as a son,
my tears pour into my chest!
Thinking about my old mother, as a son,
to swallow food and tea is difficult!
Searching for my old mother, as a son,
I cannot sleep day and night!

Si-Lang, *Searching for Mother*, Tenth-Century Beijing Opera

Melancholy and depression know no geographic boundaries, as shown in this thousand-year-old Chinese aria describing the physical aspects of depression. Depression has been documented in virtually all cultures; worldwide, depression affects about 270 million people. In the United States, the lifetime prevalence of depression among people of African and Hispanic ancestry is about 15%; among people of European ancestry, it's 23%. among Native Americans, 28% (Hasin, Sarvet, & Meyers, 2018).

Besides prevalence rates, depression manifests differently among cultures. Several Native American cultures tend to experience depression as social loneliness. A typical Caucasian North American or European is likely to experience depression in terms of psychological symptoms, such as melancholy, moodiness, and lack of interest in pleasure. In Asian cultures, depression tends to be experienced as physical complaints (as in the Chinese aria above), such as fatigue, loss of appetite, and sleep problems.

Help-seeking behavior for depression also varies among cultures. Latin American and mainland Chinese men tend not to seek help for depression, fearing that doing so will stigmatize them as weak. In Japan and Hong Kong, where depression tends to be experienced as a physical ailment, people tend to consult a medical doctor for relief of physical symptoms. Latin American women and European Americans are more likely to consult mental health practitioners.

Depression can also accompany the experience of being extremely sick or injured. In such cases, depression results from a combination of factors such as grieving the loss of health, coping with the stress of being sick, lack of exercise and normal routine, disruption of regular social activities, or alterations in physiology that may change brain chemistry. Some medications can make one

susceptible to depression. Some people experience a mild form of depression called *dysthymia*. Like major depression, **dysthymia** is associated with disturbances in sleep, appetite, and the ability to concentrate.

One of the main characteristics of severe depression is a considerable degree of negative thinking characterized by severe self-criticism; negative views about the self, the world, and the future; and a variety of logic errors in assessing the self and the world. Some of these logic errors include the following.



Many things may make us feel depressed temporarily.

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- *All-or-none thinking*: seeing things as polar extremes (e.g., all good and all bad);
- *Overgeneralizing*: interpreting one setback as evidence that every similar situation will *forever* turn out badly;

- *Negative filtering*: focusing only on the negative while filtering out the positive; and
- *Disqualifying the positive*: transforming positive occurrences into negative experiences.

Becoming aware of negative thoughts (often called *negative self-talk*) opens the way to adopting positive self-images and more realistic appraisals of the world. These, in turn, help to lessen the depressive state. Cognitive behavioral therapy is a highly successful method for helping depressed people change their negative thought patterns.

Another characteristic of depression is that it can intensify itself, thus creating a depressive cycle. The depressed person's negative thoughts, social withdrawal, and loss of interest in pleasurable experiences serve to reinforce feelings of worthlessness, helplessness, gloom, and doom. Recovery from depression requires both interrupting the depressive cycle and correcting the life situation that brought on the depression. Recreational activity can divert attention from negative thinking and weaken the depression cycle.

One way to manage depression is to get life moving again. This is accomplished by establishing and achieving simple, attainable, and hopefully enjoyable goals that can be done in a brief period of time. The goals should involve movement that restores fundamental breathing and other mind–body rhythms, which may alter the chemistry of the brain to facilitate pleasant (instead of unpleasant) moods.



If a Friend Is Considering Suicide

Occasionally, a person expresses thoughts of suicide to a friend or relative. This can be extremely distressing to the listener, who may react with disbelief, panic, or avoidance. In attempting to deal with his or her own uncomfortable feelings, a listener might say things

like, "Cheer up, you've got a lot to live for," or "You're better off than I am," or "You can't be serious!" These and similar statements have the effect of denying the distressed person's feelings. Psychologists recommend instead that listeners speak directly to suicidal thoughts ("Tell me more about why you want to kill yourself."), offer the distressed person nonjudgmental empathy and concern ("Feeling bad can really hurt. I hope you feel better soon."), and firmly but patiently direct the distressed person to professional help immediately, and notify the family or call the suicide prevention line for advice: 800-273-8255.

Often suicidal individuals offer excuses for not seeing a professional and may even try to blackmail a friend into silence with threats ("I'll kill myself if you tell anyone."). The friend must hold firm and, if necessary, make an appointment with a counselor or psychiatrist at the student health center or hospital emergency room and deliver the distressed person there, or telephone the police or a suicide prevention hotline for advice (1-800-273-8255).

Also, depressed individuals can benefit from interacting with people who offer support. Remaining in seclusion only reinforces feelings of emptiness and worthlessness. With friends and family, a depressed person is better off doing a shared, enjoyable activity rather than engaging in long conversations about how lousy life is.

Several types of medication are available to treat depression (<https://medlineplus.gov/antidepressants.html>). The most widely prescribed medications are *selective serotonin reuptake inhibitors*. Other medications include tricyclic antidepressants and monoamine oxidase inhibitors. In many cases, successful treatment of mild depression with medications is aided by a placebo effect (Fournier et al., 2010). The expectation of relief may change a helpless or hopeless attitude into a more positive, optimistic outlook.

Depression is generally considered to be a medical illness. However, about 45% of depressed individuals recover on their own without any medical intervention.

Suicide

One of the most worrisome aspects of depression is the risk of suicide. Besides depression, the risk of suicide is associated with panic disorder, social phobia, PTSD, bipolar disorder, and adult attention deficit hyperactivity disorder. In the United States, suicide ranks among the 10 most frequent causes of death, accounting for

approximately 50,000 deaths per year. The number of reported suicides is thought to represent only 10% to 20% of suicide attempts. People 50 years of age and older make up the largest age group of suicides. Among young people (15 to 24 years old), suicide ranks second behind unintentional injury as a cause of death. The same is true for college students, although the suicide rate among college students is about half that of their noncollege peers. Among the 10 leading causes of death, the mortality rates of all but suicide have decreased in the past 20 years.

About 10% of college students admit to having seriously thought about or attempted suicide within the prior 12 months (American College Health Association, 2020). Frequently, attempts occur on the same day or shortly after an acute life crisis. To help avert student suicides, many colleges have developed helping services and making students aware of them. Two risk factors for suicide to which college students are particularly susceptible are social isolation and feeling ineffective. Until they can build an on-campus supportive social network, students away from home may feel lonely, insecure, and unworthy of others' attention, all of which can lead to feeling depressed. Furthermore, without a social network, they may be less able to find support when they are anxious and depressed. Feeling ineffective at school because of grade competition and a constant sense of not being able to keep up with coursework can result in feeling helpless, guilty, and ashamed.

Suicide is neither a disease nor a disorder that can be inherited. Suicides are not caused by the weather or a full moon. Generally, people consider suicide because they feel overwhelmed and painfully distressed by life, helpless to improve matters, and hopeless that life can improve. Sometimes people attempt suicide not because they really want to die, but because they want to express anger at others, signal others for help, or just escape from their troubles. In such instances, suicide attempts are often characterized by limited self-destructive acts, such as taking less than a lethal dose of sleeping pills or arranging that an attempt be discovered in time for the person to be saved.

At the time a person contemplates suicide, life seems absolutely hopeless. But few life problems are beyond solution. Life crises do improve and distressing emotions pass. Time does heal many hurts. And the experience gained by working through a distressing time of life can bring confidence, insight, and understanding. Acquiring experience and understanding, a person is better able to cope with life's problems and is better able to help others deal with their challenges. The National Suicide Prevention Lifeline (1-800-273-8255; <https://suicidepreventionlifeline.org>) is a national network of local crisis centers that provide free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Adult Attention Deficit Hyperactivity Disorder

Adult attention deficit hyperactivity disorder (ADHD) is characterized by difficulty focusing on activities, organizing and finishing tasks, managing one's time, following instructions or being overly restless, "on the go," and perceived as not thinking before acting or speaking. About 4% of adults are believed to have ADHD. Nearly 9% of American college students have ADHD (American College Health Association, 2020). Untreated ADHD in adults is associated with impaired physical and mental health, lower socioeconomic status, lower rates of professional employment, more frequent job changes, more work difficulties, and more spousal separations and divorce. Also, adults with ADHD have more automobile collisions, speeding violations, and driver's license suspensions. Moreover, adults with ADHD are likely to be distressed by the persistent discomfort of their symptoms and the personal and social problems that arise from them.

In many adults, ADHD persists from childhood, when they experienced difficulties in educational performance, discipline problems, and being labeled as intentional underachievers and lacking in intelligence. This blaming and lack of understanding and empathy often damages self-esteem, creating another problem that contributed to difficulties in performance in adulthood.

ADHD is not intentional but most likely a consequence of biological conditions in the brain. Compared with other adults, those with ADHD show differences in brain dopamine and noradrenaline neurotransmitter systems and anatomical or functional differences in the frontal regions of the brain (Rubia, Alegria, & Brinson, 2014).

College students with undiagnosed ADHD generally struggle to complete school assignments, manage their time, get good grades, and even complete their degrees. With medications, coaching, counseling, and living healthfully, however, students with ADHD can learn to stay organized and manage the tasks of college (**Table 4.3**).

Some adults with ADHD find ways to direct their bountiful energy, curiosity, and desire for novelty to achieve success in careers as physicians, journalists, attorneys, salespeople, professional athletes, and in the arts.

TABLE 4.3	Success Strategies for Students with ADHD
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Keep a day-planner and a to-do list.

Use a backpack as an organizer. Put pens and pencils in outside pockets, notebook in another pocket, and homework in another. Keep books inside.

Keep an assignment notebook. Every day list all assignments, quizzes, and exams, and check them off when completed.

Create a two-pocket homework folder. Label one pocket “Work to Be Done” and put all assignment sheets therein. Label the other pocket “Work Completed” and put all finished assignments therein. Check the folder every day.

Help yourself pay attention in class. Sit close to the instructor to lessen distractions. Use a voice recorder for lectures and studying.

Let others help you. If friends and instructors know about your ADHD, they are more likely to help you stay organized and on top of your tasks.

Autism Spectrum Disorders

Autism spectrum disorders (ASDs), also called *pervasive developmental disorders*, are a group of conditions characterized by varying degrees of impairment in communication skills and social interactions and restricted, repetitive, and stereotyped patterns of behavior. People with an ASD can seem to be absorbed in themselves and separate from interaction with others. The word *autism* is derived from the Greek *autos*, meaning “self,” and *ismos*, meaning “state of being.”

Approximately 1 in 75 children throughout the world is diagnosed with an ASD—a prevalence exceeding that of diabetes, spina bifida, or Down syndrome. In most cases, problems in communication and social skills become noticeable early on as the child lags behind age peers. Parents may report normal development that suddenly changes as the child starts to reject people, act strangely, and lose previously acquired language and social skills.

There is no single best treatment for all children with an ASD. Parents and health practitioners must approach helping affected children with an openness to experimenting with a variety of treatment options. Successful programs tend to involve well-planned, structured teaching of specific skills, although success is variable.

The nonspecific approach to treating ASD reflects both the wide variety of manifestations of the condition and a likely multiplicity of causes. For most of the 20th century, the cause of autism was thought to be improper parenting leading to impaired social development. Research eventually disproved that hypothesis, opening the way to consideration of biological factors. For example, a popular hypothesis—not supported by research—is that mercury used as a preservative in vaccines impairs brain development in some susceptible children. And although ASD is not related to the inheritance of a single gene, the condition is associated with a variety of genetic anomalies that seem to occur after conception,

perhaps from the toxic effects of environmental pollutants on the developing brain.

Healthy Sleep

All living things exhibit cycles of rest and activity, which in humans are represented by the daily sleep–wake cycle. Every person has a sleep–wake cycle that corresponds to his or her optimal degree of physical, mental, and spiritual well-being. The duration and pattern for optimum sleep for most adults is 7 to 8 hours of uninterrupted sleep per night, with some needing less sleep and others more. The duration of sleep is less significant than whether an individual awakens feeling refreshed, vital, and able to function optimally. Nearly 80% of American college students report not getting enough sleep on most days of the week to feel rested the next morning (American College Health Association, 2020).

Adequate sleep enhances attentiveness, concentration, mood, and motivation. Inadequate sleep, on the other hand, impairs concentration, memory, and the ability to be productive, good-humored, satisfied with life, and even to laugh at a joke! Lack of sleep can gravely impair judgment: Sleeplessness is second only to drunkenness as a cause of automobile accidents. Inadequate sleep is linked to all-cause and cardiovascular mortality, susceptibility to stress, excess body weight, and perturbed immune functioning.

Sleep is a basic biological function controlled by a region of the brain called the *master clock*, which is synchronized to the environmental light–dark cycle. This is the reason that unperturbed sleep and wakefulness are on a near-24 hour or *circadian* rhythm. In daytime, the master clock activates many other biological clocks throughout the body that control physiological processes, including the brain's wakefulness center. As night falls, the master clock initiates the production of **melatonin**, a hormone that promotes sleep. When the day–night circadian sleep rhythm is thrown off, for example, by shift work, travel through time zones, or overwork, a person can have difficulty falling asleep, can wake up during the night and be unable to get back to sleep, or be unable to sleep as

long as he or she wants into the morning. This can increase the risk of excessive daytime sleepiness, moodiness, memory problems, lack of concentration, and disruption of a variety of biological systems that depend on circadian rhythms.

Besides circadian rhythm, the sleep–wake cycle is controlled by brain mechanisms called the **homeostatic sleep drive**. After being awake for a long period of time, people experience increasing sleepiness or *sleep pressure*. The need for sleep gets stronger the longer a person stays awake and decreases during sleep, reaching a low after a full night of good-quality sleep. After awakening, sleep pressure begins to build, eventually initiating another cycle, and “crashing” if sleep does not occur. Sleep drive helps to maintain sleep throughout the night.

The human sleep–wake cycle is highly sensitive to exposure to light. Certain light-sensitive cells in the eyes tell the brain whether it is day or night, information the brain uses to regulate sleep. The brain is most sensitive to light from about 2 hours before usual bedtime and through the night until about 1 hour after usual wake up in the morning. Exposure to light during these times will affect when your body naturally gets sleepy and is ready to fall asleep. According to the U.S. Centers for Disease Control and Prevention (2021):

- Bright evening light 2 hours before bedtime will shift the time for sleep later, so you will tend to get sleepy and fall asleep later in the evening and will wake up later in the morning.
- If you have trouble falling asleep, keep the light levels dim for the 2 hours before you want to go to sleep. You can wear dark sunglasses (wraparound ones work best) if it is hard to control the light in the area. If you are getting sleepy too early in the evening, you can go into a well-lit area to reduce the sleepiness. However, if you are sleep deprived or fighting an infection, go to sleep early and catch up on needed sleep.

- Bright morning light will shift the time for sleep earlier, so you will tend to get sleepy and fall asleep earlier in the evening and will wake up earlier in the morning. If you are waking up too early and cannot fall back to sleep, make sure you keep the lights as dim as possible until the time you want to wake up. If you cannot wake up early enough, go into a brightly lit area when you get up (for example, eat your breakfast outside or next to a sunny window).
- If you have to get up in the middle of the night, keep light level dim.

There are two basic types of sleep: **rapid eye movement (REM)** sleep and non-REM sleep (consisting of three stages called 1, 2, and 3). Each stage has a specific brain wave pattern and activity. A person cycles through all stages of REM and non-REM sleep several times during a typical night, with increasingly longer and deeper REM periods occurring toward the end of the sleep cycle (**Figure 4.2**). In REM sleep, the eyes move rapidly from side to side behind closed eyelids, brain wave activity becomes closer to that seen in wakefulness, breathing becomes faster and irregular, and heart rate and blood pressure increase to near waking levels.

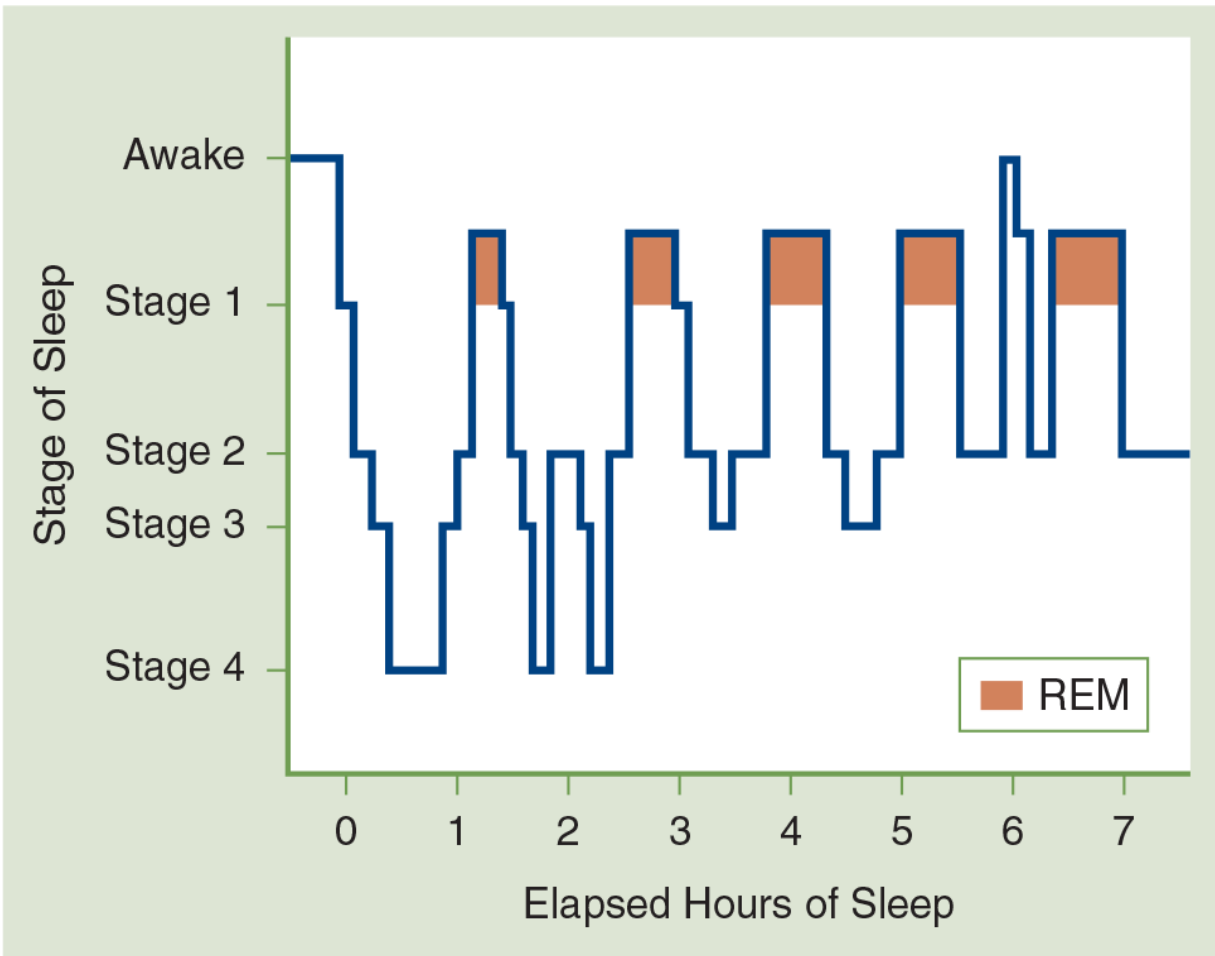


Figure 4.2 The Human Sleep Cycle. The graph shows changes in brain activity during sleep as measured by an electroencephalogram. Human sleep is composed of five stages, through which one cycles every 90 to 120 minutes during a sleep episode.

U.S. Coast Guard. (2003, January). *Crew Endurance Management Practices: A Guide for Maritime Operations*.

Description

Most dreaming occurs during REM sleep, although some dreaming can also occur in non-REM sleep. When dreaming, the arms and legs become temporarily paralyzed, which prevents acting out the dreams. With age, people tend to spend less time in REM sleep. Memory consolidation most likely requires both non-REM and REM sleep.



Self-Care: Self-Compassion for Academic Success

and Lifelong Well-Being

Undesired experiences that cause pain and suffering are a part of life. Among these are disappointment, failure, personal harm and injury, tragedy, trauma, loss, and betrayal. Compassion is a response to suffering in which one experiences empathy for another's or one's own suffering and commits to relieving that suffering. Other words for compassion are *caring* and *helpfulness*. Compassion increases positive feelings such as liking and contentment and decreases threat-activated emotions such as anger, fear, and disgust, and it reduces inflammation and other physiological manifestations of stress.

The college student experience can be one of the most rewarding in life—and also one of the most challenging. One way to assist in getting the most out of college and preparing oneself for the inevitable up and downs of life is the practice of self-compassion.

Self-compassion is a psychological term that refers to the process of liking and caring for oneself and offering support and kindness to oneself in times of failure, setback, and distress. Some people are self-compassion “naturals.” They take care of themselves the way they would a loved family member or a close friend. They do their best to live healthfully and forgive themselves and others when goof-ups occur. Other people may be pretty good at being caring and supportive with others but not with themselves when mistakes and setbacks occur. They can be intolerantly self-critical (“activating the inner critic”). They might stop practicing healthy behaviors that they know are good for them or not follow through on school assignments. Studies show that self-compassion is related to a higher sense of well-being and less risk of being stymied by anxiety, depression, stress, and fear of failure (Gunnell, Mosewich, McEwen, Eklund, & Crocker, 2017). Self-compassion training has been successful at enhancing psychological resilience among students (Smeets, Neff, Alberts, & Peters, 2014) and collegiate athletes (Mosewich, Crocker, Kowalski, & DeLongis, 2013).

Psychologists have identified three components of self-compassion:

1. Self-kindness rather than harsh self-criticism.
2. Acceptance of the truth that all humans make mistakes; no one is perfect.
3. Being emotionally balanced by not misattributing setbacks to one's flaws.

You can determine your own level of self-compassion using Professor Kristin Neff's Self-Compassion Scale (self-compassion.org/test-how-self-compassionate-you-are). If you decide to improve your self-compassion skills, you can follow Professor Neff's online tutorials (self-compassion.org).

Good sleep requires diminished physiological and psychological arousal caused by heightened sympathetic nervous system activity

(e.g., caused by caffeine, a prebedtime cigarette, or anger, worry, and stress). Exposure to bright light, such as from a computer screen, can delay falling to sleep. Reading bedtime stories to children is a time-honored way to diminish their sympathetic nervous system arousal and provide a transition to sleep. Methods common to adults include reading before bedtime, prayer or meditation, taking a warm bath, and having a light snack. Drinking alcohol, while possibly contributing to drowsiness, actually impairs falling asleep and getting restful sleep.

Sleep researchers believe that a majority of Americans are sleeping 60 to 90 minutes a night less than the 7 or 8 hours that would leave them refreshed and energetic during the day. Individuals “cheat on their sleep” to create time for other things in their busy schedules. Many consider sleep to be expendable and not sleeping a sign of ambition and drive. Furthermore, around-the-clock electronic entertainment and the Internet can distract people from sleeping. Before the advent of the electric light bulb in the late 1800s, people tended to sleep about 9 hours a night. When it got dark, people slept.

College Students and Sleep

Deprive, deprive, deprive, deprive, crash. This is an especially common sleep pattern among college students. During the week, students deprive themselves of sleep to complete their academic tasks, work, interact with electronic media, and socialize, and on the weekend they pay back their “sleep debt” with one or two extended episodes of sleep. Because this pattern is prevalent, it may seem normal, but it has drawbacks. For example, shortened sleep time, erratic sleep–wake schedules, and poor sleep quality are associated with lower academic performance, thus creating the irony that the motivation to sleep less to produce more is counterproductive (Prichard, 2020). Sleeping only 4 to 6 hours a night can reduce the ability to pay attention, react to a stimulus, think quickly, not make mistakes, and multitask.

Many college students experience times of disturbed or unrestful sleep. They go to bed—but instead of falling asleep, they lie awake thinking about their to-do list, personal problems, an upcoming exam or speech, and just about anything else that enters their minds. Or they fall asleep, but after a few hours they awaken—ruminating—and cannot readily go back to sleep. Having not gotten a good night's sleep (or two or three), when awake they are irritable, depressed, tired, have low motivation (even for things they like), and have diminished concentration. Frequently, when academic pressures relent and stress subsides, normal, restorative sleep returns. It is possible, however, that the factors producing disturbed sleep become habitual, causing chronic insomnia (see the following section).



Sufficient sleep and dreams are essential to mental health.

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Getting a Good Night's Sleep

Here are some suggestions for getting a good night's sleep.

- *Establish a regular sleep time.* Give your own natural sleep cycle a chance to be in synchrony with the day–night cycle by going to bed at the same time each night (within an hour more or less) and arising *without being awakened by an alarm*. This will mean going to bed early enough to give yourself enough time to sleep. Try to maintain your regular sleep times on the weekend. Getting up early during the week and sleeping late on weekends may upset the rhythm of your sleep cycle.

- *Create a proper (for you) sleep environment.* Sleep occurs best when the sleeping environment is dark, quiet, free of distractions, and not too warm. If you use radio or TV to help you fall asleep, use an autotimer to shut off the sound after falling asleep.
- *Wind down before going to bed.* About 30 to 60 minutes before bedtime, stop any activities that cause mental or physical arousal such as work or exercise, talking or texting, and playing video games and take up a “quiet” activity that can create a transition to sleep. Transitional activities could include reading, watching “mindless” TV, taking a warm bath or shower, meditation, or making love.
- *Make the bedroom for sleeping only.* Make the bedroom your place for getting a good night’s sleep. Try not to use it for work or for discussing problems with your partner.
- *Don’t worry while in bed.* If you are unable to sleep after about 30 minutes in bed because of worry about things in your life, get up and do some limited activity such as reading a magazine article, doing the dishes, or meditating. Go back to bed when you feel drowsy. If you cannot sleep because of thinking about all that you have to do, write down what’s on your mind and let the paper hold onto the thoughts while you sleep. You can retrieve them in the morning. You can also redirect your attention from your mind to your body by doing Progressive Muscle Relaxation (see the final Wellness Guide in this chapter), taking three calming breaths (see Chapter 9’s Wellness Guide on “The Calming Breath”), or conducting a body

scan (see Chapter 7's Wellness Guide, "Self-Care: The Body Scan").

- *Avoid alcohol, caffeine, and tobacco.* Some people have a glass of beer or wine before bed to relax. Large amounts of alcohol, although sedating, block normal sleep and dreaming patterns. Because caffeine remains in the body for several hours, people sensitive to caffeine should not ingest any after noon. Nicotine is a stimulant, so it should be avoided before bedtime.
- *Exercise regularly.* Exercising 20 to 30 minutes three or four times a week enhances the ability to sleep. You should not exercise vigorously within 3 hours of bedtime, however, because of the possibility of becoming too aroused to sleep.

Sleep Problems

Because of life's never-ending array of challenges, just about everyone has trouble sleeping once in a while. Experiences that commonly disrupt sleeping patterns include being sick, jet-lagged, nervous about an upcoming exam, or excited about something new; having consumed too much food, alcohol, or caffeine; or losing a loved one. Fortunately, most people tend to adjust to these situations, and their sleep rhythms return to normal (for them). A large percentage of Americans, however, have problems with sleeping that last several weeks to years. The most common sleep problems are not sleeping enough (insomnia), sleeping during the day (excessive daytime sleepiness), and unusual activities associated with sleep (parasomnias).

Insomnia

The majority of people with long-term sleep problems have **insomnia**. They have trouble falling asleep or staying asleep, or they awaken after a few hours of sleep and cannot go back to sleep. The

daytime results of insomnia are fatigue, the desire to nap, impaired ability to concentrate, impaired judgment, and a lack of zest for life. Although insomnia may be related to disease or injury in the brain's sleep centers, most often it is the result of a physical illness, chronic pain, stress, depression, anxiety, obsessive–compulsive ruminations, panic attacks, PTSD, or excessive drug or alcohol use.

Sometimes, as a result of insomnia, individuals have a difficult time staying awake during the day. They may feel sleepy most of the time, may nod off easily during a routine activity, or may nap at the slightest opportunity. Because they get insufficient sleep at night, about 20% of college students can fall asleep almost instantaneously if permitted to lie down in a darkened room. An extreme tendency to fall asleep during the day is called *narcolepsy*.

Insomnia is related to a variety of physical health problems, including more sick days, high blood pressure, type 2 diabetes, chronic respiratory disease, arthritis, pain, and headache. Insomnia increases the risks of depression, anxiety, and substance abuse. Because lack of sleep is a form of stress and thus promotes the production of stress hormones, it tends to perpetuate itself.

People with insomnia may try to improve their situation by going to bed early, staying in bed longer even though not sleeping, or trying to nap. Some try alcohol and sleep medications. In general, these strategies fail because they disrupt the biology of sleep and do not address the root causes of insomnia: negative expectations about one's ability to get to sleep and the consequent physiological arousal created by those thoughts. In other words, worrying about not sleeping is psychophysiologicaly stimulating and thus defeats getting to sleep. To overcome insomnia, one must follow the suggestions for adequate sleep hygiene, practice some form of relaxation (e.g., meditation, progressive muscle relaxation), and become aware of and change one's worry about getting to sleep. For example, instead of worry, one acknowledges that one worries ("There's that worry again") and then reminds oneself that the worry is both unnecessary ("It's not true that I will fail at getting to sleep again") and counterproductive ("These thoughts aren't helping me"). Changing one's thoughts about sleep and learning proper sleep

hygiene are more effective for insomnia than medications are (Trauer, Qian, Doyle, Rajaratnam, & Cunningham, 2015). Moreover, many prescription sleep drugs (hypnotics, antidepressants, barbiturates) can be dangerous ([MayoClinic.com](https://www.mayoclinic.com), 2018).

Parasomnias

Parasomnias occur in many forms and have the potential to interrupt restful sleep. Common parasomnias include the following:

- *Nightmares*, dreams that arouse feelings of fear, terror, anxiety, or panic.
- *Somnambulism*, also known as *sleepwalking*. This is a condition occurring primarily in children and often associated with anxiety, fatigue, or stress. The person performs motor activity, usually leaving bed and walking around, while sleeping and has no memory of it on awakening. Other vigorous behaviors such as punching, kicking, and night terrors (episodes that begin with a loud cry followed by rapid heart rate, sweating, and feelings of panic) will also interrupt sleep.
- *Sleep apnea*, in which breathing stops or gets extremely shallow for about 10 to 20 seconds and then resumes with a snort or choking sound. These pauses can occur 20 to 30 times or more an hour.
- *Restless legs syndrome* is characterized by a powerful urge to move the legs, often described as a creeping, crawling, tingling, or burning sensation. The urge to move and unpleasant feelings occur when resting and inactive, thus making it hard to fall asleep and stay asleep.

Because the majority of sleep problems represent some form of disharmony within ourselves or with our surroundings, restoring harmony is a way to return to our natural rest–activity cycle. This can be accomplished by employing mind–body health practices such as meditation, exercise, and proper nutrition. For extreme sleep disorders, professional help should be sought.



Progressive Muscle Relaxation

Progressive muscle relaxation (PMR) involves tightening individual muscles or muscle groups for 5 seconds and slowly releasing to create a reflex relaxation. Follow the directions below or listen to the University of Michigan audio at <https://mari.umich.edu/psych-clinic/pmr-audio>.

Note: If you experience muscle cramps while doing this exercise, either (1) straighten out the muscle or (2) “breathe through” the muscle by closing your eyes and imagining that air is entering your body through the tight muscle instead of your lungs. If cramping or any other aspect of this exercise is uncomfortable, you may stop.

PMR Exercise (15–20 minutes)

Phase 1: Sinking into the Floor

Put yourself in quiet, comfortable surroundings.

Shoes off, clothes loosened.

Lie on your back on a soft or padded surface.

Set feet slightly apart with palms facing upward.

Close your eyes; breathe naturally.

Observe thoughts without focusing on them.

As if it were a sponge, imagine the surface on which you are lying drawing tension from your body. As tension leaves your body, notice that it feels as though you are sinking into the floor.

Breathe naturally.

Lie quietly for at least 2 minutes.

Phase 2: Lower-Body PMR

Focus your awareness on your feet. Breathe normally.

Keeping your heel on the floor, point the toes on your left foot away from you as far as you can. Hold 5 seconds and slowly release.

Repeat for right foot.

Rest, breathe naturally, and observe the sensation that follows.

Keeping your heel on the floor, point the toes on your left foot toward you as far as you can. Hold 5 seconds and slowly release.

Repeat for right foot.

Rest, breathe naturally, and observe the sensation that follows.

With leg outstretched, tighten the thigh muscles of your left leg. Hold 5 seconds and slowly release.

Repeat for right leg.

Rest, breathe naturally, and observe the sensation that follows.

Tense pelvic (butt) muscles. Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

Phase 3: Upper-Body PMR

Tense stomach muscles. Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

With palms turned down and keeping your forearm on the floor, bend your left hand at the wrist and point the fingers back as far as they will go. Hold 5 seconds and slowly release.

Repeat for right hand.

Rest, breathe naturally, and observe the sensation that follows.

With palms turned up and keeping your forearm on the floor, bend your left hand at the wrist and point the fingers toward your face as far as they will go. Hold 5 seconds and slowly release.

Repeat for right hand.

Rest, breathe naturally, and observe the sensation that follows.

Tense muscles of the left upper arm. Hold 5 seconds and slowly release.

Repeat for right arm.

Rest, breathe naturally, and observe the sensation that follows.

Tense the muscles in your back. Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

Tense the muscles in your shoulders.

Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

Phase 4: Head and Neck PMR

Tense the muscles in your neck. Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

Tense the muscles in your face. Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

Close your eyes and squeeze the lids tightly shut. Hold 5 seconds and slowly release.

Rest, breathe naturally, and observe the sensation that follows.

Dreaming and Health

Nearly everyone dreams while asleep. Even some animals dream. Although some people deny they dream, this is because they do not recall their dreams when awake. On the other hand, some people have vivid recall of the several dreams they have each night (a skill that can be developed).

Dreams tend to occur in the stage of sleep called *rapid eye movement* (REM) sleep (see Figure 4.2). REM sleep encompasses about 25% of sleep time, and it dominates sleep time in the last half of the night.

No one knows why people dream. Some researchers suggest that REM sleep is necessary for brain growth, daily information processing, and cellular rejuvenation. Others postulate that dreams are the brain's way of processing and eliminating information and memories that are no longer useful. Whatever the reasons, dreams are necessary for health. Experimental subjects who were deprived of the chance to dream (they were awakened by experimenters during REM sleep) developed bizarre behaviors and psychotic symptoms. The individuals returned to normal after at least one night of catching up on the missed REM time.

For thousands of years dreams have been used in many cultures to restore mental and physical health. The temples of Asclepius were

used by ancient Greeks for more than a thousand years as places where people went to have healing dreams and to have them interpreted by the priests and priestesses.

Indications that dreams can be healthy come from studies of the Senoi, a Malaysian tribe known as the “Dream People.” The Senoi live in a nonaggressive, noncombative, communal society. The tribe’s members have a remarkable degree of mental and emotional health, which is attributed by some to the daily ritual of discussing and interpreting their dreams. Both children and adults gather each morning to recount their dreams to one another, singly and in groups. According to Senoi custom, the events, anxieties, and people in a dream are real and must be acknowledged and dealt with. Such behavior is similar to our custom of looking for meaning in dreams, especially as a component of psychotherapy.

Critical Thinking About Health

1. Dr. Razmataz's book, *30 Days to Exceptional Mental Health*, had been on the best-seller charts for 10 weeks, but after his appearance on TV's *Inside This Week*, sales went through the roof. Entertainers, business executives, professional athletes, and political leaders extolled the value of his program to lessen needless worry, improve sleep, and enhance mood, self-esteem, memory, and mental acuity.

Dr. Razmataz based his program on 10 years of research he conducted as director of the Ersatz Mental Health Clinic. In his book and his media appearances, Dr. Razmataz explained that the type and severity of a particular mental illness were caused by either the over- or underactivity of the genes that controlled the production of the six basic neurotransmitter chemicals in the brain. The key to his method was determining a patient's genetic profile and matching it to one of six specific organic food diets.

What factors are mentioned in the description above that might suggest to someone that Dr. Razmataz's method is credible and efficacious?

Which of these factors do you find influence you when you are making a health decision?

What additional information, if any, would you want before trying Dr. Razmataz's method yourself or recommending it to someone else? How would you find such information?

2. List five characteristics of a mentally healthy person. If you were a parent, how would you ensure that your child grows up to manifest the five characteristics on your list? Also discuss how individuals can contribute to the mental health of people in their community.
3. John hasn't liked being Margie's supervisor since her first day of work. She just doesn't get it. And because she's the boss's niece, there is little he can do. In the past 6 months, whenever Margie is

on John's shift team, he finds himself so distressed that he doesn't want to go to work.

The chapter describes strategies for coping with emotional distress, including (1) changing the situation that is causing the distress, (2) altering the significance one places on the distressing situation, and (3) lessening the distressing emotions. Discuss how John could employ each of these coping strategies to lessen his emotional distress. Also describe the consequences for John of implementing each coping strategy.

When you experience emotional distress, which of the three coping strategies do you employ most often? Do you notice situations in which one coping strategy works better than others?

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Mental health and mental illness are more difficult to recognize and define as compared to physical health and physical illness. Symptoms of physical illness are usually specific and clearly measurable or observable—elevated temperature, coughing, nausea, or diarrhea. Symptoms of mental illness are often less well defined or consistent. We all feel “down in the dumps” sometimes, but that is distinctly different from clinical depression, which is a form of mental illness. Normal emotions run the gamut from joy, happiness, pleasure, and contentment to sadness, anger, hostility, and despair. All of us experience mood swings all of the time, and these are normal emotional reactions to things we are experiencing. However, the extremes in mood swings experienced by a person with a manic–depressive disorder are uncontrolled and disabling unless treated. Trained counselors and mental health professionals can help you recognize and cope with emotions that upset and disturb your mental equilibrium. Mental wellness is characterized by feelings of happiness, optimism, vitality, and appreciation of life.

Strong social support from family, friends, teachers, and spiritual figures fosters mental health. Living in a family unit with parents and siblings who care for and express love for one another also helps prevent serious negative mood swings. Sometimes a few good jokes can wipe out despondency and despair. So you did not get the meetup that you desired so intensely. So what? You will have many more dates and dances in your life. Negative emotions can be controlled if you make the effort. For example, anger is an emotion that everyone experiences. You often hear the expression “She [or he] made me so angry!” In fact, if you think about it for a moment, you will see that everyone who is angry has made themselves angry. Something has happened or been said that you decided to react to with anger. You could just as easily have smiled and walked away.

Mental health begins with taking control of your emotions and deciding which ones allow you to live in harmony with yourself and with those around you.

HIGHLIGHTS

- Mental health is when your mental functions produce a sense of optimism, vitality, and well-being and when your intentional behaviors lead to productive activities (including healthy behaviors), fulfilling relationships with others, and the ability to adapt to change and to cope with adversity.
- Mental illness refers to alterations in thinking, emotions, or intentional behaviors that produce psychological distress or impaired functioning.
- Mental and emotional health depend on how well individuals meet their maintenance and growth needs and cope with situations in which their needs are not met.
- People understand their needs by interpreting what they sense from the environment and in their bodies. As they mature, people develop ideas about and learn strategies to meet their emotional needs.
- Emotional distress occurs when needs are not met. People cope with emotional distress by changing their modes of interaction with the environment, changing the importance of their unmet needs, or changing the distressing feelings.
- Counselors, therapists, and others can help clarify the source of emotional distress and find healthy ways to cope with it.

- Social support enables individuals to receive resources to help during difficult times.
- Phobias are exaggerated and often unrealistic fears.
- Anxiety disorders include social anxiety disorder, panic disorder, generalized anxiety disorder, and obsessive–compulsive disorder.
- Depression is often characterized by feelings of dejection, guilt, hopelessness, self-recrimination, loss of appetite, insomnia, loss of interest in sexual activity, withdrawal from friends, inability to concentrate, lowered self-esteem, and a focus on the negative.
- Suicide is the third leading cause of death among persons aged 15 to 24 years, of all races and both genders.
- Adult attention deficit hyperactivity disorder is the result of conditions in the brain.
- Sleep and dreams are fundamental to human health. Sleep has five stages. REM sleep, during which dreams occur, happens during the cycle of sleep from deep to lighter stages.
- Many people use their dreams to help them understand and deal with distressing situations and confusing emotions.

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KEY TERMS

mental health:

a sense of optimism, vitality, and well-being, and intentional behaviors that lead to productive activities, fulfilling relationships with others, and the ability to adapt to change and to cope with adversity

mental illness:

alterations in thinking, emotions, and/or intentional behaviors that produce psychological distress and/or impaired functioning

coping:

efforts to manage a stressful situation regardless of whether those efforts are successful

coping strategies:

ways people devise to prevent, avoid, or control the emotional distress of unfulfilled needs

emotions:

patterns of brain activity that can arise spontaneously or in response to what is experienced, has been experienced, or believed to be experienced.

cognitive behavioral therapy (CBT):

treatment of psychological distress by examining and changing thoughts that underlie it

social support:

resources that one receives from others, particularly people in one's immediate social network with whom one has emotional bonds and/or social ties

phobia:

a powerful and irrational fear of something

anxiety:

the fear of an imaginary threat

intermittent anxiety:

relatively short term anxiety readily identified as a response to a specific upcoming event or situation; remits when the feared situation or event passes.

ongoing anxiety:

long lasting, physiologically and psychologically intense anxiety which can intensify over time, interfere with many parts of life, and impair daily functioning and health.

avoidance:

distracting oneself from feeling anxious but not doing anything to address the cause

major depressive disorder:

a long-lasting depressive state of episodes of deep depression that is not self-limiting

bipolar disorder:

episodes of depression followed by episodes of mania

seasonal affective disorder (SAD):

depressive symptoms that appear in autumn or winter and remit spontaneously in spring

dysthymia:

a long-lasting, mild form of depression

adult attention deficit hyperactivity disorder (ADHD):

difficulty focusing on activities, organizing and finishing tasks, managing one's time, following instructions and/or being overly restless, "on the go," and perceived as not thinking before acting or speaking

autism spectrum disorders (ASD):

a group of conditions characterized by degrees of impairment in interpersonal interaction

melatonin:

hormone that promotes sleep

homeostatic sleep drive:

sleep–wake cycle is controlled by brain mechanisms

rapid eye movement (REM):

stage of sleep in which dreams occur

insomnia:

prolonged inability to obtain adequate sleep

parasomnias:

activities that interrupt restful sleep



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CHAPTER 5

Choosing a Healthy Diet



Health Tips

Healthier Eating: One Step at a Time

Power Up! Do Breakfast

Estimating Your Daily Calorie Needs



Dollars & Health Sense

Ways to Reduce Food Waste



Global Wellness

There's Good News and There's Bad News

The Mediterranean Diet

The Paleo Diet



Wellness Guide

Taking Care of Your Teeth and Gums

Rules for Organic Labeling

Guidelines for Food Safety

Tips for Eating Healthy When Eating Out

Self-Care Exercise: Fast Food Research

LEARNING OBJECTIVES

1. List several factors that influence dietary choices.
2. Define nutrient-dense food and calorie-dense food.
3. Describe the Mediterranean Diet and the DASH Diet.
4. Explain the ingredients and nutrition facts labels on manufactured foods.
5. Describe the three functions of food.
6. List the three functions of biological energy.
7. List the seven components of food and identify common foods that contain each component.
8. List at least three guidelines for food safety
9. Describe several reasons for vegetarianism and the kinds of vegetarian diets.

Everyone knows it's important to eat right to be healthy. Given that the United States is the wealthiest country in the world and produces enough food to feed all its inhabitants and many millions more in other countries, it's shocking that the American diet is woefully unhealthy (Mozaffarian & Goldman, 2019). According to the University of Washington's U.S. Burden of Disease Collaborators, dietary factors are associated with about 530,000 of the 2.7 million annual U.S. deaths (Mokdad et al., 2019). The culprits are easy to identify: too much consumption of refined grain products, processed meats, saturated fat, and commercial foods with added sugar, and salt, and too little consumption of whole grains, fruits, vegetables, fish, and nuts and seeds. Add too much alcohol consumption if alcohol, contributing 7 calories per gram, is considered a food.

Nutrition scientists have identified the kinds, amounts, and proportions of foods that make up a healthy diet (**Table 5.1**). Also, modern food production and distribution systems can potentially provide human populations with a variety of good tasting, nutritious food. Unfortunately, however, North Americans consume diets not in accordance with optimal health (**Figure 5.1**).

TABLE 5.1 | **Healthy Eating Pattern: Recommended Intake Amounts in U.S.**

	Calorie Level of Pattern ^a
--	---------------------------------------

Food Group	1,600	2,000	2,400
Vegetables	2 c-eq	2½ c-eq	3 c-eq
Dark-green vegetables (c-eq/wk)	1½	1½	2
Red and orange vegetables (c-eq/wk)	4	5½	6
Legumes (beans and peas) (c-eq/wk)	1	1½	2
Starchy vegetables (c-eq/wk)	4	5	6
Other vegetables (c-eq/wk)	3½	4	5
Fruits	1½ c-eq	2 c-eq	2 c-eq
Grains	5 oz-eq	6 oz-eq	8 oz-eq
Whole grains (oz-eq/day)	3	3	4
Refined grains (oz-eq/day)	2	3	4
Dairy	3 c-eq	3 c-eq	3 c-eq
Protein Foods	5 oz-eq	5½ oz-eq	6½ oz-eq
Seafood (oz-eq/wk)	8	8	10
Meats, poultry, eggs (oz-eq/wk.)	23	26	31
Nuts, seeds, soy products (oz-eq/wk.)	4	5	5
Oils	22 g	27 g	31 g
Limit on Calories for Other Uses (% of calories)^{e,f}	130 (8%)	270 (14%)	350 (15%)

c-eq = cup equivalent

^aPatterns from 1,600 to 3,200 calories are designed to meet the nutritional needs of children 9 years and older and adults. If a child 4 to 8 years of age needs more calories and, therefore, is following a pattern at 1,600 calories or more, his or her recommended amount from the dairy group should be 2.5 cups per day. Children 9 years and older and adults should not use the 1,000-, 1,200-, or 1,400-calorie patterns.

^bFoods in each group and subgroup are:

Vegetables

- Dark-green vegetables: All fresh, frozen, and canned dark-green leafy vegetables and broccoli, cooked or raw: for example, broccoli; spinach; romaine; kale; collard, turnip, and mustard greens.
- Red and orange vegetables: All fresh, frozen, and canned red and orange vegetables or juice, cooked or raw: for example, tomatoes, tomato juice, red peppers, carrots, sweet potatoes, winter squash, and pumpkin.
- Legumes (beans and peas): All cooked from dry or canned beans and peas: for example, kidney beans, white beans, black beans, lentils, chickpeas, pinto beans, split peas, and edamame (green soybeans). Does not include green beans or green peas.
- Starchy vegetables: All fresh, frozen, and canned starchy vegetables: for example, white potatoes, corn, green peas, green lima beans, plantains, and cassava.
- Other vegetables: All other fresh, frozen, and canned vegetables, cooked or raw: for example, iceberg lettuce, green beans, onions, cucumbers, cabbage, celery, zucchini, mushrooms, and green peppers.

Fruits

- All fresh, frozen, canned, and dried fruits and fruit juices: for example, oranges and orange juice, apples and apple juice, bananas, grapes, melons, berries, and raisins.

Grains

- Whole grains: All whole-grain products and whole grains used as ingredients: for example, whole-wheat bread, whole-grain cereals and crackers, oatmeal, quinoa, popcorn, and brown rice.
- Refined grains: All refined-grain products and refined grains used as ingredients: for example, white breads, refined grain cereals and crackers, pasta, and white rice. Refined grain choices should be enriched.

Dairy

- All milk, including lactose-free and lactose-reduced products and fortified soy beverages (soy milk), yogurt, frozen yogurt, dairy desserts, and cheeses. Most choices should be fat free or low fat. Cream, sour cream, and cream cheese are not included because of their low calcium content.

Protein Foods

- All seafood, meats, poultry, eggs, soy products, nuts, and seeds. Meats and poultry should be lean or low fat and nuts should be unsalted. Legumes (beans and peas) can be considered part of this group as well as the vegetable group but counted in one group only.

^cFood group amounts shown in cups or ounce-equivalents (oz-eq). Oils are shown in grams (g). Quantity equivalents for each food group follow.

- Vegetables and fruits—1 cup-equivalent is 1 cup raw or cooked vegetable or fruit, 1 cup vegetable or fruit juice, 2 cups leafy salad greens, ½ cup dried fruit or vegetable.
- Grains—1 ounce-equivalent is ½ cup cooked rice, pasta, or cereal; 1-ounce dry pasta or rice; 1 medium (1 ounce) slice bread; 1 ounce of ready-to-eat cereal (about 1 cup of flaked cereal).
- Dairy—1 cup-equivalent is 1 cup milk, yogurt, or fortified soy milk; 1½ ounces natural cheese such as cheddar cheese or 2 ounces of processed cheese.
- Protein foods—1 ounce-equivalent is 1-ounce lean meat, poultry, or seafood; 1 egg; ¼ cup cooked beans or tofu; 1 Tbsp peanut butter; ½ ounce nuts or seeds.

^dAmounts of whole grains in the patterns for children are less than the minimum of 3 oz-eq in all patterns recommended for adults.

^eAll foods are assumed to be in nutrient-dense forms, lean or low fat and prepared without added fats, sugars, refined starches, or salt. If all food choices to meet food group recommendations are in nutrient-dense forms, a small number of calories remain within the overall calorie limit of the pattern (i.e., limit on calories for other uses). The number of these calories depends on the overall calorie limit in the pattern and the amounts of food from each food group required to meet nutritional goals. Nutritional goals are higher for the 1,200- to 1,600-calorie patterns than for the 1,000-calorie pattern, so the limit on calories for other uses is lower in the 1,200- to 1,600-calorie patterns. Calories up to the specified limit can be used for added sugars, added refined starches, solid fats, alcohol, or to eat more than the recommended amount of food in a food group. The overall eating pattern also should not exceed the limits of less than 10% of calories from added sugars and less than 10% of calories from saturated fats. At most calorie levels, amounts that can be accommodated are less than these limits. For adults of legal drinking age who choose to drink alcohol, a limit of up to 1 drink per day for women and up to 2 drinks per day for men within limits on calories for other uses applies; and calories from protein, carbohydrate, and total fats should be within Acceptable Macronutrient Distribution Ranges (AMDRs).

^fValues are rounded.

U.S. Department of Agriculture, *Dietary Guidelines for Americans, 2020–2025*. /dietaryguidelines.gov

Description Description

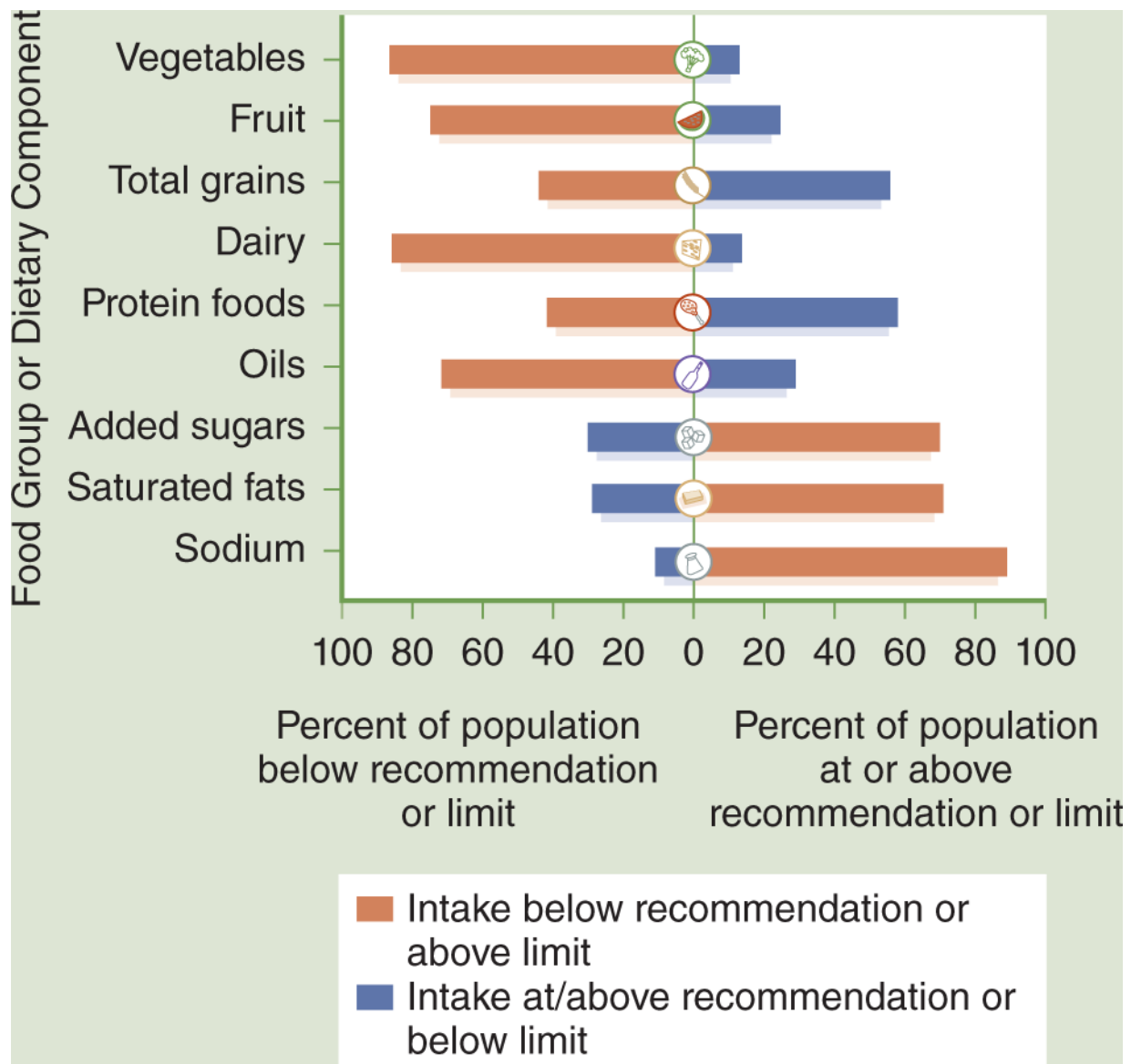


Figure 5.1 Dietary Intakes Compared to Recommendations. Percentage of the U.S. Population Ages 1 Year and Older Who Are Below, at, or Above Each Dietary Goal or Limit. The “0” line is the goal intake. Orange sections of a bar indicate consumption below goal intake; blue sections indicate consumption above goal intake.

U.S. Department of Agriculture, Dietary Guidelines for Americans, 2015–2020.

Description

The common American diet, also called the *standard Western diet*, is based on meats, refined-flour products, and industrial products such as fast food and packaged fatty or sugary snacks and sweets.

Compare the American diet to the traditional Asian and Mediterranean diets, which are based on whole unprocessed grains, beans, fresh vegetables and fruits, and fish. Both are associated with less heart disease and several kinds of cancer because they maintain healthy body weight, lessen inflammation and insulin resistance, and improve blood vessel functioning (see the Global Wellness box “The Mediterranean Diet”).

Although the typical North American supermarket stocks about 40,000 products, many of them are inexpensive, manufactured, low quality, unhealthy, digestible material labeled as food. Healthful living requires consumption of foods—preferably in their natural state—that are **nutrient dense**, which means that they provide high levels of nutrients, like vitamins and minerals, per calorie of energy compared to other foods. For example, even though they offer approximately the same amount of energy (about 100 calories), an apple is more nutrient dense than a serving of 10 potato chips because it provides more fiber, vitamin C, and several other vitamins than the chips do, with no added fat and salt. According to the U.S. Department of Agriculture (USDA), “all vegetables, fruits, whole grains, seafood, eggs, beans and peas, unsalted nuts and seeds, fat-free and low-fat dairy products, and lean meats and poultry—when prepared with little or no added solid fats, sugars, refined starches, and sodium—are nutrient-dense foods.”

Unfortunately, the U.S. food supply contains an abundance of inexpensive food products that are calorie dense, while not being nutrient dense. **Calorie dense** means offering considerable energy in the form of (usually added) sugar and saturated fat but lack reasonable quantities of other nutrients. Calorie-dense foods include many pastries, candies, and most fast foods and **processed foods**, which are industrial products derived from natural foods to which salt, sugar, oils and fats, and other chemicals such as flavorings, colorings, sweeteners, and thickeners are added to alter taste, color, palatability, and resistance to spoilage and to disguise any undesirable qualities arising from the manufacturing process (Martinez Steele et al., 2015). Overconsumption of calorie-dense foods creates the paradox in that many people are simultaneously

overfed and undernourished, and it also increases the risk for overweight, heart disease, high blood pressure, diabetes, kidney disease, and some cancers (Murray et al., 2016). About 67% of the North American food supply is manufactured food. The remaining 33% is in its natural state.



The Mediterranean Diet

A Key to Healthy Eating

The Mediterranean Diet is associated with longer life and a reduced risk of heart disease and cancer. It's a diet based on whole grains, fresh fruits and vegetables, minimal animal and trans fat, and little red meat.

What Is a Mediterranean Diet?

- Meals based on whole-grain foods: breads, pasta, couscous, polenta, bulgur
- Abundant fresh vegetables and fruits
- Generous amounts of beans, nuts, and seeds
- Olive oil as the principal source of fat
- Use of garlic, onions, and herbs as condiments
- Moderate use of fish
- Moderate use of dairy
- Minimal use of red meat
- Low to moderate intake of alcohol

What Makes the Mediterranean Diet Healthy?

- Low in saturated fat and cholesterol
- Energy supplied by unsaturated fat (in olive oil and nuts)
- No trans fats (artificial fats in packaged pastries and margarine)
- High in fiber
- High in antioxidants
- Low in refined sugar and flour
- High in plant-based vitamins and micronutrients

Researchers in France have determined that the Mediterranean Diet lowers the risk of heart disease and many types of cancer. Even though a large percentage of calories is

derived from fat, mono- and polyunsaturated fats predominate, the kind that raise high-density lipoprotein (HDL) (so-called good **cholesterol**). Almost absent are animal fats (saturated fats and cholesterol) and manufactured trans fats, which raise low-density lipoprotein (LDL) (so-called bad cholesterol). The Mediterranean Diet's high levels of antioxidants and other micronutrients reduce the risk of cardiovascular disease and cancer.

The typical American dinner, with a slab of meat in the center and one or two "sides," consisting of an overcooked vegetable and a butter-drenched potato, is a far cry from a typical Mediterranean Diet dinner: pasta made of unrefined flour topped with a variety of minimally cooked vegetables (tomatoes, onions, peppers), some beans (peas, fava beans), and a sprinkle of hard cheese (Parmesan or Romano). For dessert, the Mediterranean Diet calls for almonds and fresh fruit instead of cake, cookies, or ice cream.

It's too much to ask Americans to change generations of dietary habits overnight. However, there are ways to incorporate some of the healthier aspects of the Mediterranean Diet without radically changing customary eating patterns:

- Cut back on fast food, which is generally 50% saturated fat and cholesterol.
- Replace cake and ice cream desserts with fruit salad and nuts.
- Replace meat-centered meals with grain- and bean-centered ones.
- Replace doughnuts and sugar-laden snacks with fruit and mixed nuts.

Bon appétit!

Dietary Guidelines for Eating Right

Many people realize that their eating pattern is not as healthy as it could be, and most would probably want to make healthier food choices. But the plethora of claims and counterclaims about what consumers should eat are as likely to confuse as enlighten. Nutrition scientists and doctors try to educate the public about healthy eating, but often their explanations are too technical for most people to comprehend readily (Buckton, Lean, & Combet, 2015). Moreover, the quest for authoritative nutritional guidance can be thwarted by the efforts of self-professed experts and commercial interests whose goals are profits rather than health education.

My weaknesses have always been food and men—in that order.

—Dolly Parton

To help consumers develop strategies for eating healthfully, the World Health Organization, the U.S. and Canadian governments, and health organizations such as the American Heart Association and the American Cancer Society put forth specific guidelines for healthful nutrition. These guidelines are based on the latest scientific evidence for good nutrition created by examining the biological effects of specific dietary components and by comparing eating patterns and disease frequencies in different populations. For example, every 5 years, the USDA issues dietary guidelines for the American people (U.S. Department of Agriculture, 2020) that are designed to promote wellness and prevent illnesses that result from poor nutrition, including:

- heart disease, cancer of various organs, type 2 diabetes, and overweight from diets high in sugar and saturated fat;

- cancer of the colon from consumption of too much processed and cooked red meat;
- diseases of the gastrointestinal tract from not consuming sufficient fiber;
- high blood pressure from consuming too much salt; and
- tooth decay and overweight from consuming too much sugar, added to almost every packaged food product (Popkin & Hawkes, 2016).

The guidelines also stress the importance of physical activity in maintaining a healthy body weight.

To help consumers remember the most important dietary recommendations, the USDA has developed **MyPlate** (**Figure 5.2**), a graphic consisting of a plate divided into four sections for fruits, vegetables, protein, and grains with a dairy cup beside it. MyPlate is intended to encourage consumers to observe the following guidelines.

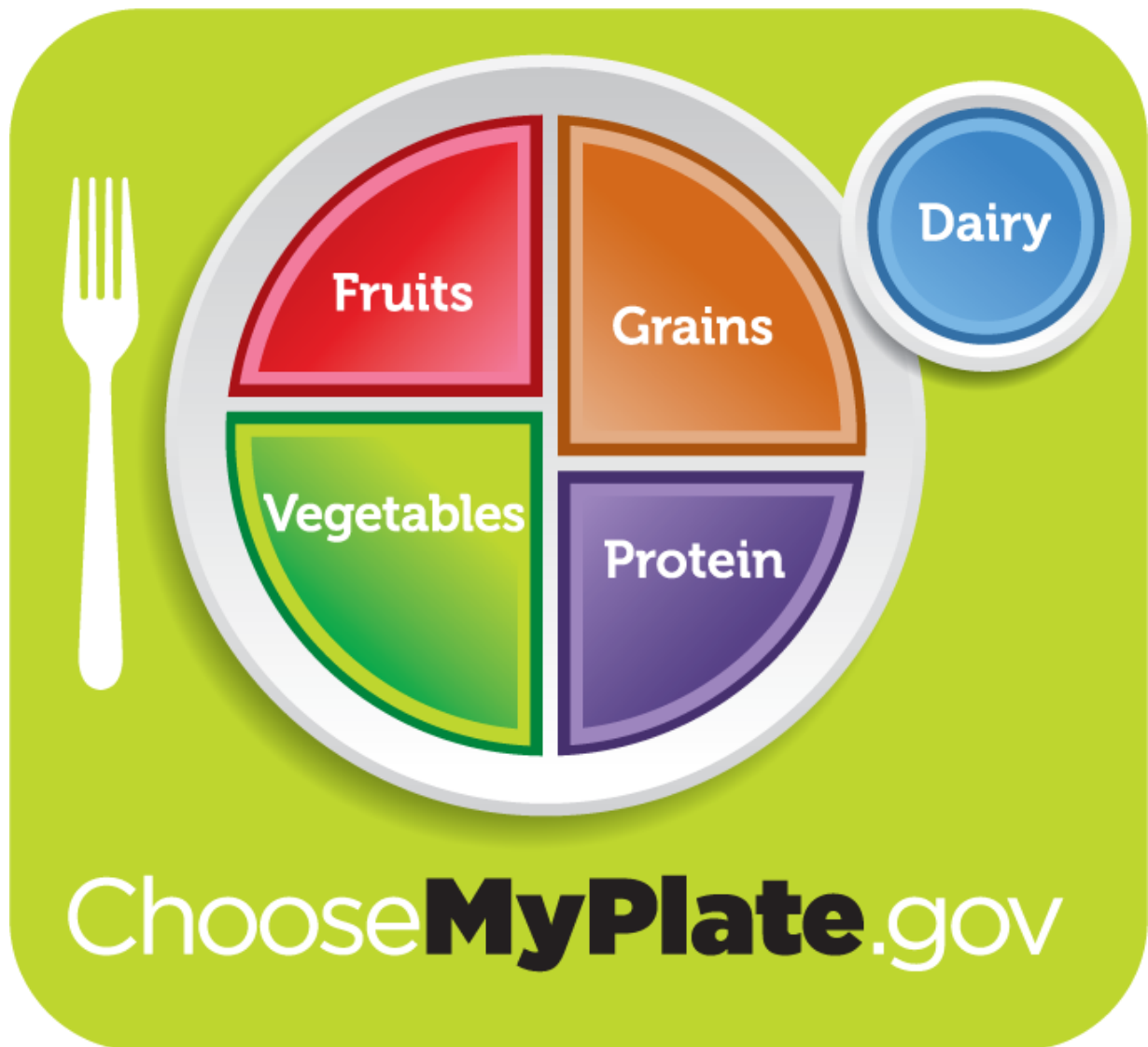


Figure 5.2 MyPlate can help you eat balanced meals.

Courtesy of U.S. Department of Agriculture.

Description

- Enjoy food, but avoid oversized portions.
- Make nearly half your plate fruits and vegetables of all colors. (Potatoes and french fries don't count.)
- Make at least half your grains whole grains.

- Consume one to two servings per day of fat-free or low-fat (1%) milk.
- Drink water instead of sugary drinks.
- Choose packaged and frozen food items that contain less salt and sodium (check the product label).
- For protein, choose fish, poultry, beans, and nuts; limit red meat, bacon, cold cuts, and other processed meat.

The USDA also has produced the Dietary Approaches to Stop Hypertension (DASH) Diet) for people with high blood pressure (**Figure 5.3**).



Figure 5.3 The DASH Eating Plan.

© Hemera/Thinkstock

Food Labels: Know What You're Putting into Your Body

Few people in developed countries grow their own food or obtain it directly from growers and preparers. Instead, they get much of their food prepackaged with added sugar, salt, artificial flavorings, and preservatives or it is prepared in restaurants with ingredients of unknown quality, amounts, purity, and sources. Thus, it can be difficult for consumers to judge the nutritional value and sometimes safety of food products they consume.



There's Good News and There's Bad News

The good news is that in recent years the diet of much of the world's human population has gotten healthier (Imamura et al., 2015). The bad news is that during that same time period the diet of much of the world's population has gotten less healthy. How could that be?

The answer is that, on the whole, the people of the world are consuming more healthy foods and more unhealthy foods. Researchers compared the dietary patterns of adults in 187 countries in the years 1990 and 2010, considering 10 healthy and 7 unhealthy dietary constituents. In high-income countries, consumption of healthy dietary constituents increased and that of unhealthy items declined a bit. In low-income countries, however, consumption of healthier dietary constituents decreased and that of unhealthy dietary items increased. Also, even though consumption of unhealthy dietary items decreased among residents of high-income countries, their diets still had greater amounts of unhealthy items than those in low-income countries did. A diet high in unhealthy constituents is the major risk factor for heart and blood vessel disease, the two most common causes of death in the world (World Health Organization, 2015).

The DASH eating plan shown in the accompanying table is based on 2,000 calories a day. The number of daily servings in a food group may vary from those listed, depending on your caloric needs. Use this chart to help you plan your menus or take it with you when you go to the store.

Healthy Dietary	Unhealthy Dietary Constituents	Constituents
Fruits	High sodium	
Vegetables	High trans fats	
Beans and legumes	Processed meats	
Whole grains	Red meat	
Nuts and seeds	Sugar-sweetened beverages	
Milk	Saturated fat	
Fiber	Cholesterol	
Calcium		
Omega-3 fatty acids		
Polyunsaturated fatty acids		
Fish		

Food Group	Daily Servings (Except as Noted)	Serving Sizes	Examples and Notes	Significance of Each Food Group to the DASH Eating Plan
Grains and grain products	6–8	1 slice bread 1 oz dry cereal* ½ cup cooked rice, pasta, or cereal	Whole-wheat bread, English muffin, pita bread, bagel, cereals, grits, oatmeal, crackers, unsalted pretzels, and popcorn	Major sources of energy and fiber
Vegetables	4–5	1 cup raw leafy vegetable ½ cup cooked vegetable 6 oz vegetable juice	Tomatoes, potatoes, carrots, green peas, squash, broccoli, turnip greens, collards, kale, spinach, artichokes, green beans, lima beans, sweet potatoes	Rich sources of potassium, magnesium, and fiber
Fruits	4–5	4 oz fruit juice 1 medium fruit ¼ cup dried fruit ½ cup fresh, frozen, or canned fruit	Apricots, bananas, dates, grapes, oranges, orange juice, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, prunes, raisins, strawberries, tangerines	Important sources of potassium, magnesium, and fiber
Low-fat or fat-free dairy foods	2–3	8 oz milk 1 cup yogurt 1 ½ oz cheese	Fat-free (skim) or low-fat (1%) milk, fat-free or low-fat buttermilk, fat-free or low-fat regular or frozen yogurt, low-fat and fat-free cheese	Major sources of calcium and protein
Lean meats, poultry, and fish	6 or less	3 oz cooked meats, poultry, or fish	Select only lean; trim away visible fats; broil, roast, or boil instead of frying; remove skin from poultry	Rich sources of protein or magnesium
Nuts, seeds, and dry beans	4–5 per week	⅓ cup or 1½ oz nuts 1 Tbsp or ½ oz seeds ½ cup cooked dry beans, peas	Almonds, filberts, mixed nuts, walnuts, sunflower seeds, kidney beans, lentils	Rich sources of energy, magnesium, potassium, protein, and fiber
Fats and oils [†]	2–3	1 tsp soft margarine 1 Tbsp low-fat mayonnaise 2 Tbsp light salad dressing 1 tsp vegetable oil	Soft margarine, low-fat mayonnaise, light salad dressing, vegetable oil (such as olive, corn, canola, or safflower)	DASH has 27% of calories as fat, including fat in or added to foods
Sweets	5 per week	1 Tbsp sugar 1 Tbsp jelly or jam ½ oz jellybeans 8 oz lemonade	Maple syrup, sugar, jelly, jam, fruit-flavored gelatin, jellybeans, hard candy, fruit punch, sorbet, ices	Sweets should be low in fat
Maximum sodium limit	2,300 mg per day			

*Equals ½–1¼ cups, depending on cereal type. Check the product's Nutrition Facts label.

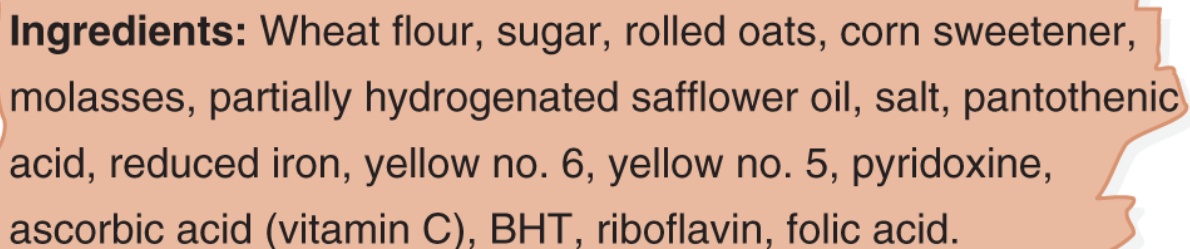
[†]Fat content changes serving counts for fats and oils; for example, 1 Tbsp of regular salad dressing equals 1 serving.

U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute (2021). What is the DASH Eating Plan? Available at <http://www.nhlbi.nih.gov/health/health-topics/dash-eating-plan>

Description Description

To help consumers assess the quality and safety of food products, the U.S. government is among the many governments that require food manufacturers to provide certain information about a product on its packaging label. In the United States, the information consists of the name and address of the manufacturer, packer, or distributor; the **ingredients label**; the **Nutrition Facts label**; and any required allergy labeling. The package can also state if the product is gluten free and include any health claims supported by scientific research.

The ingredients label (**Figure 5.4**) lists the chemical composition of the food—that is, all the substances that the manufacturer uses, including other foods (e.g., grains, eggs), natural and artificial sweeteners, natural and artificial fats, water, natural and artificial thickeners, natural and artificial flavorings, food colorings, and preservatives. The ingredients label lists substances in descending order by weight; the substance in the greatest amount is listed first and that in the least amount is listed last.



Ingredients: Wheat flour, sugar, rolled oats, corn sweetener, molasses, partially hydrogenated safflower oil, salt, pantothenic acid, reduced iron, yellow no. 6, yellow no. 5, pyridoxine, ascorbic acid (vitamin C), BHT, riboflavin, folic acid.

Figure 5.4 The Ingredients Label. The U.S. government requires that food manufacturers list the substances within their products by weight from greatest to least.

The ingredients label does not specify how much—either by weight or percentage—of an ingredient is in a food product, only its amount relative to the other ingredients. Also, by listing each individual substance, the ingredients label may not indicate the true relative amount of sugar or fat in a product. For example, a snack

product's ingredients label could list separately sucrose, fructose, high-fructose corn syrup, and corn sweetener, all of which are sugars.

The ingredients label must also contain food allergy information. About 160 foods are known to cause food allergies in sensitive individuals, although eight foods—milk, egg, fish, crustacean shellfish, tree nuts, wheat, peanuts, and soybeans—account for 90% of all food allergies. If one or more of these foods is an ingredient in a food product or the product contains a protein derived from one or more of them, either the ingredients label must identify that ingredient in parentheses following the common or usual name of the major food allergen in the list of ingredients or below the ingredients list with the word *Contains* followed by the name of the food source from which the major food allergen is derived (e.g., “Contains Wheat, Milk, Egg, and Soy”). The allergy notification must appear immediately after or adjacent to the list of ingredients and in a type size that is no smaller than the type size used for the list of ingredients. Allergens other than the major food allergens are not subject to labeling requirements.



Healthier Eating: One Step at a Time

If you want to improve your diet, make only one healthful change at a time. Here are some suggestions:

- Eat a breakfast consisting of at least a whole-grain product and a fruit.
- Substitute one daily serving of real fruit juice or tea (not colored sugar water or an energy drink) for a soda.
- Substitute one daily serving of a fruit or nuts for a candy bar or a handful (or two) of chips.
- Substitute a lean meat sandwich with tomato on whole-wheat bread for a fast-food hamburger, fried fish entrée, taco, pizza, or burrito.

Unlike the ingredients label, the Nutrition Facts label provides *quantitative* information on calorie content and certain nutrients in a food (**Figure 5.5**). The amounts indicated for each nutrient and the calorie count are for a “serving,” which is all or a portion of the contents of the package, as determined by the manufacturer (**Figure 5.6**). The manufacturer’s definition of a serving is given at the top of the Nutrition Facts label as the “serving size.”

Serving size

Serving size is based on the **amount of food that is customarily eaten** at one time. **All** of the nutrition information listed on the nutrition facts label is based on **one serving** of the food.

- When comparing calories and nutrients in different foods, check the serving size in order to make an accurate comparison.

Servings per container

Servings per container shows the **total number of servings** in the entire food package or container. One package of food may contain more than one serving.

- If a package contains *two servings* and you eat the entire package, you have consumed *twice the amount of calories and nutrients* listed on the label.

Calories

Calories refers to the **total number of calories**, or “energy,” supplied from all sources (fat, carbohydrate, protein, and alcohol) in one serving of the food. To achieve or maintain a healthy weight, balance the number of calories you consume with the number of calories your body uses.

As a general rule:
100 calories per serving is **moderate**
400 calories per serving is **high**

Calories from fat

Calories from fat are not additional calories, but are **fat’s contribution to the total number of calories** in one serving of the food.

- “Fat-free” doesn’t mean “calorie-free.” Some lower fat food items may have as many calories as the full-fat versions.

% Daily value

Percent daily value (%DV) shows **how much of nutrient** is in one serving of the food. The %DV column doesn’t add up vertically to 100%. Instead, the %DV is the percentage of the daily value (the amounts of key nutrients recommended per day for Americans 4 years of age and older) for each nutrient in one serving of the food.

As a general rule:
5% DV or less of a nutrient per serving is **low**
20% DV or more of a nutrient per serving is **high**

Nutrients

The nutrition facts label can help you learn about and compare the **nutrient content** of many foods in your diet. Use it to choose products that are lower in nutrients you want to get less of and higher in nutrients you want to get more of.

Nutrients to get less of - get less than 100% DV of these nutrients each day: saturated fat, *trans* fat, cholesterol, and sodium.
(Note: *trans* fat has no % DV, so use the amount of grams as guide)

Nutrients to get more of - get 100% DV of these nutrients on most days: dietary fiber, vitamin A, vitamin C, calcium, and iron.

Nutrition Facts

Serving size 1 package (272g)

Servings per container 1

Amount per serving

Calories 300

Calories from fat 45

% Daily value*

Total fat 5g	8%
Saturated fat 1.5g	8%
<i>Trans</i> fat 0g	
Cholesterol 30mg	10%
Sodium 430mg	18%
Total carbohydrate 55g	18%
Dietary fiber 6g	24%
Sugars 23g	
Protein 14g	
Vitamin A	50%
Vitamin C	35%
Calcium	6%
Iron	15%

* Percent daily values are based on 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

		Calories: 2,000	2,500
Total fat	Less than	65g	80g
Saturated fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total carbohydrate	Less than	300g	375g
Dietary fiber	Less than	25g	30g

Footnote with daily values

Some of the %DVs are based on a **2,000 calorie daily diet**. However, your daily values may be higher or lower depending on your calorie needs, which vary according to age, gender, height, weight, and physical activity level. Check your calorie needs at <http://www.choosemyplate.gov>.

- If there is enough space available on the food package, the **daily values** and **goals** for some key nutrients are given for both a 2,000 and 2,500 calorie daily diet.

Figure 5.5 The Nutrition Facts Label.

U.S. Food and Drug Administration (2021). How to Understand and Use the Nutrition Facts Label. <https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label>

Description Description

1 Serving looks like...

GRAIN PRODUCTS



1 cup of cereal flakes = fist

1 pancake = compact disc



$\frac{1}{2}$ cup of cooked rice, pasta, or potato = $\frac{1}{2}$ baseball



1 slice of bread = passport



1 piece of cornbread = bar of soap

SOAP

1 Serving looks like...

VEGETABLES AND FRUIT

1 cup of salad greens = baseball



1 baked potato = fist



1 med. fruit = baseball

$\frac{1}{2}$ cup of fresh fruit = $\frac{1}{2}$ baseball



$\frac{1}{4}$ cup of raisins = large egg



1 Serving looks like...

DAIRY AND CHEESE



1 $\frac{1}{2}$ oz. cheese = 4 stacked dice or 2 cheese slices

$\frac{1}{2}$ cup of ice cream = $\frac{1}{2}$ baseball



1 Serving looks like...

MEAT AND ALTERNATIVES

3 oz. meat, fish, and poultry = deck of cards



3 oz. grilled/baked fish = checkbook



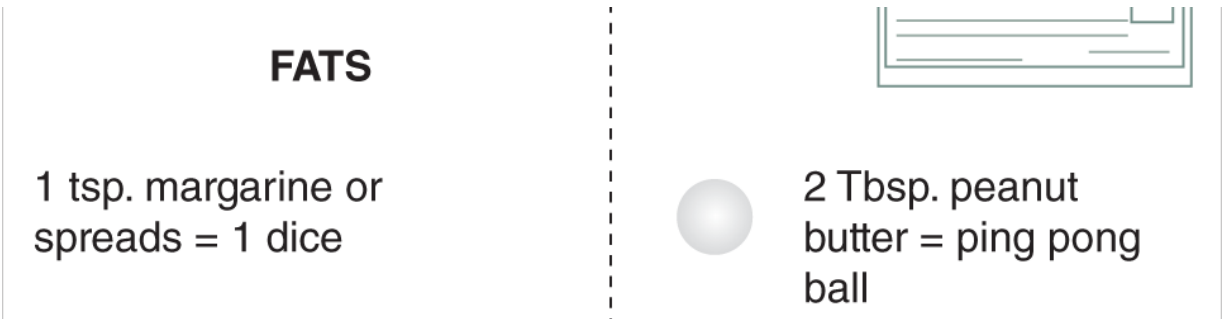


Figure 5.6 What's a Serving?
Description

The Nutrition Facts label also lists the **percent daily value (PDV)** for each nutrient, which is the percentage of the recommended daily amount that is contained in the food (**Table 5.2**). (The percent daily value on the Nutrition Facts label is for someone who requires 2,000 calories of food energy per day; people with higher or lower calorie requirements have a larger or smaller PDV.) Near the bottom of the Nutrition Facts label is the recommended daily amount of nutrients, listed by weight (in grams) for 2,000-calorie-per-day diets.

TABLE 5.2 | **Daily Values (DV) for Adults and Children Over Four Years of Age Based on a Caloric Intake of 2,000 Calories**

Food Component	DV
Total Fat	65 grams (g)
Saturated Fat	20 g
Cholesterol	300 milligrams (mg)
Sodium	2,400 mg
Potassium	3,500 mg
Total Carbohydrate	300 g

Food Component	DV
Dietary Fiber	25 g
Protein	50 g
Vitamin A	5,000 International Units (IU)
Vitamin C	60 mg
Calcium	1,000 mg
Iron	18 mg
Vitamin D	400 IU
Vitamin E	30 IU
Vitamin K	80 micrograms (mcg)
Thiamin	1.5 mg
Riboflavin	1.7 mg
Niacin	20 mg
Vitamin B ₆	2 mg
Folate	400 mcg
Vitamin B ₁₂	6 mcg
Biotin	300 mcg
Pantothenic acid	10 mg
Phosphorus	1,000 mg
Iodine	150 mcg
Magnesium	400 mg

Food Component	DV
Zinc	15 mg
Selenium	70 mg
Copper	2 mg
Manganese	2 mg
Chromium	120 mg
Molybdenum	75 mg
Chloride	3,400 mg

U.S. Food and Drug Administration.

(<http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/Labeling/Nutrition/ucm064928.htm>) U.S. National Institutes of Health, 2017. Nutrient

Recommendations: Dietary Reference Intakes.

(https://ods.od.nih.gov/Health_information/Dietary_Reference_intakes.aspx.)

To help consumers determine health-related claims on food labels, the U.S. government requires manufacturers to adhere to certain definitions (**Table 5.3**).

TABLE 5.3 What Words on Product Labels Mean

Calorie Free	Fewer than 5 Calories Per Serving
Low calorie	No more than 40 calories for a given reference amount (except sugar substitutes)
Light (lite)	One-third less calories or no more than one-half the fat of the higher-calorie, higher-fat version; or no more than ½ the sodium of the higher-sodium version
Fat free	Less than 0.5 g of fat per serving

Calorie Free	Fewer than 5 Calories Per Serving
Low fat	3 g or less of total fat for a given reference amount
Reduced or less fat	At least 25% less fat per serving than the higher-fat version
Lean	Less than 10 g of fat, 4 g of saturated fat, and 95 mg of cholesterol per serving
Extra lean	Less than 5 g of fat, 2 g of saturated fat, and 95 mg of cholesterol per serving
Low in saturated fat	1 g saturated fat (or less) per serving and not more than 15% of calories from saturated fatty acids
Saturated fat free	Less than 0.5 g saturated fat for a given reference amount, and no more than 0.5 g of trans fatty acids
Cholesterol free	Less than 2 mg of cholesterol and 2 g (or less) of saturated fat per serving
Low cholesterol	20 mg of cholesterol (or less) and 2 g of saturated fat (or less) per serving
Reduced cholesterol	At least 25% less cholesterol than the higher-cholesterol version, and 2 g (or less) of saturated fat per serving
Sodium free (no sodium)	Less than 5 mg of sodium per serving, and no sodium chloride (NaCl) in ingredients
Very low sodium	35 mg of sodium (or less) per serving
Low sodium	140 mg of sodium (or less) per serving
Light in sodium or lightly salted	At least 50% less sodium than the regular product

Calorie Free	Fewer than 5 Calories Per Serving
No salt added or unsalted	No salt added during processing
Reduced or less sodium	At least 25% less sodium per serving than the higher-sodium version
Sugar free	Less than 0.5 g of sugar per serving
High fiber	5 g of fiber (or more) per serving
Good source of fiber	2.5 to 4.9 g of fiber per serving
Gluten free	Not derived from wheat, rye, barley, or crossbreeds of these grains and does not contain more than 20 parts per million of gluten from added ingredients

Restaurants and similar retail food establishments with 20 or more locations are required to list calorie content information for standard menu items on restaurant menus and menu boards, including drive-through menu boards. Other nutrient information—total calories, fat, saturated fat, cholesterol, sodium, total carbohydrates, sugars, fiber, and total protein—must be made available in writing on request. Vending machine operators who own or operate 20 or more vending machines must disclose calorie content for certain items.

Although not required to be on a product label, most packaged foods carry a **date label** that is distinguished by the words “Sell by,” “Use by,” “Best by,” or “Best Used by.” Most consumers interpret a date label as “use it by that time or expose yourself and your family to a health risk.” This interpretation is incorrect. Date labels are not expiration dates for health reasons, except for infant formula; there are no U.S. standards for date markings on food product labels. Generally, they refer to the manufacturer’s or a store’s assessment of when the product is at peak quality. In a few states and in some

countries, date labels have a specific meaning by law, but rarely do they indicate a health risk.

Besides date labels, packaged and canned foods can carry strings of numbers and letters and specific dates. These are codes that refer to when the product was manufactured. They enable manufacturers and retailers to rotate their stock as well as locate their products in the event of a health recall.

Because people misinterpret the dates on products to mean “no longer safe,” they tend not to buy them even if they are still safe to consume after the sell-by date. Manufacturers and retailers remove the products, thus contributing to the wasting of 15% to 20% of the country’s food supply. The average American family of four wastes more than \$1,500 worth of food per year (see the Dollars & Health Sense box, “Ways to Reduce Food Waste”). Many major food manufacturers follow U.S. Department of Agriculture guidelines to apply only one date label, “Best if Used By/Before,” to indicate when a product will be of best flavor or quality. It is not a purchase or safety date.



Ways to Reduce Food Waste

Plan

Make a weekly menu. Prepare a shopping list noting how many meals you’ll make with each item and buy no more than what you expect to use. Keep a list of meals and their ingredients that you enjoy. Avoid buying foods you already have. Buying in bulk is thrifty only if you use the food before it spoils.

Store

Store fruits and vegetables for maximum freshness. Freeze, preserve, or can surplus fruits and vegetables. To slow ripening, store bananas, apples, and tomatoes by themselves, and store fruits and vegetables in different bins. Wash berries prior to eating to prevent mold.

Prep

Wash, dry, chop, dice, slice, and place fresh food items in clear storage containers soon after shopping for use later in the week. Prep and freeze meals ahead of time. Freeze bread, sliced fruit, or meat you know won't eat soon.

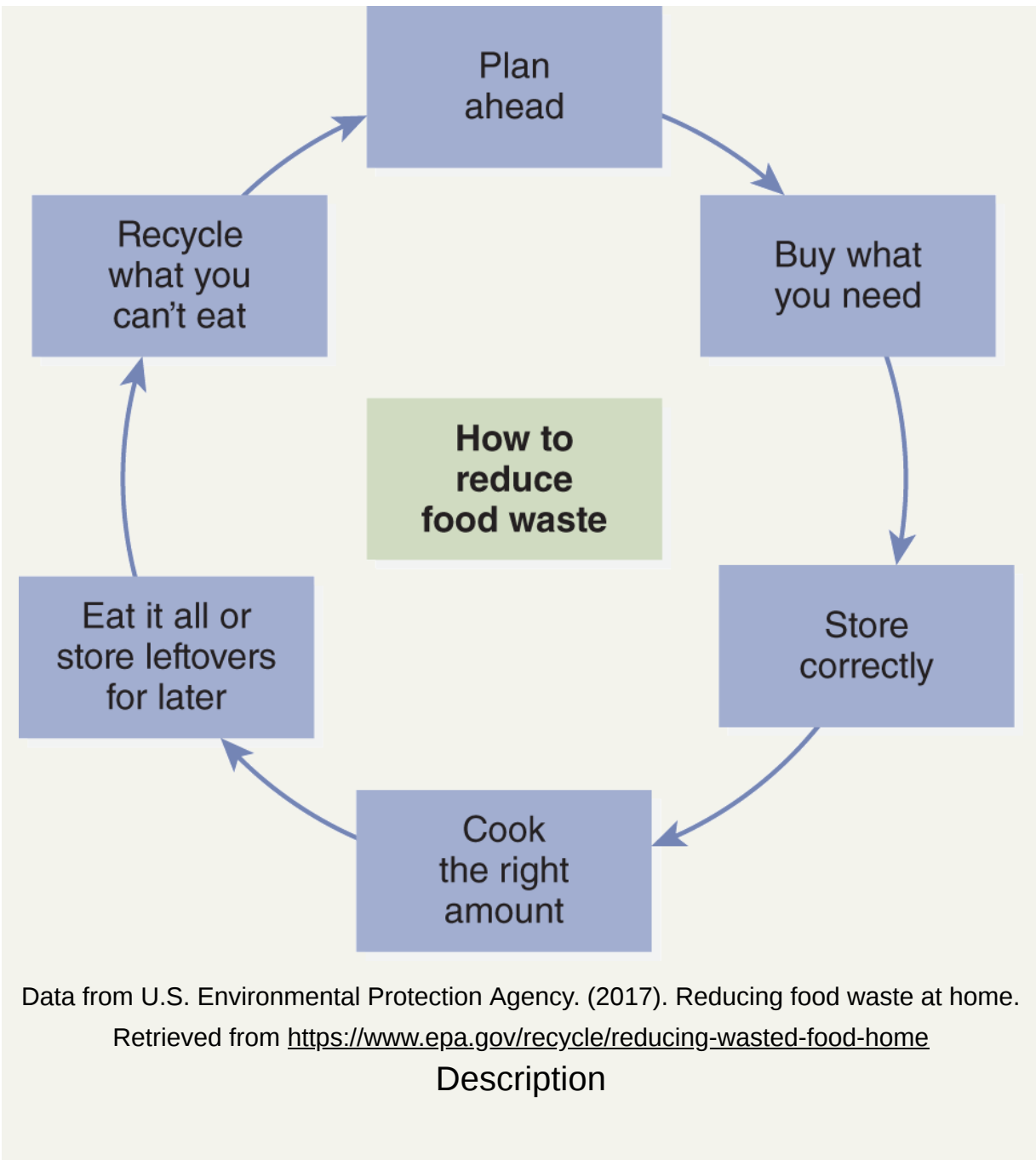
Save Money

Before buying more, cook or eat what you already have at home (soups, casseroles, stir fries, sauces, baked goods, pancakes, or smoothies). Use the edible parts of food that you normally do not eat (stale bread for croutons, sautéed beet tops, vegetable scraps for stock). Have "eat the leftovers" night each week. At restaurants, order only what you can finish; be aware of side dishes included with entrees; take home the leftovers for your next meal.

Divert from Landfills

Donate to food banks nutritious, safe, and untouched food.

Compost food scraps rather than throw them away.



The Three Functions of Food

Food has three functions:

- 1. to provide the chemical constituents of the body;
- 2. to provide the energy for life; and
- 3. to be pleasurable, including satisfying hunger; being appealing in its smell, taste, sight, and texture; and being associated with enjoyable social activities

Providing Chemical Constituents

Your body is made up of billions of atoms and molecules arranged in particular combinations and proportions. Most of the atoms and molecules that now make up your body were not part of you even a few weeks ago because living things continually exchange their chemical constituents with the environment. The food you consume provides your body with replacement chemicals, which are used to manufacture the biological substances that make you *you*. Your body can manufacture most of the chemicals it needs, but it cannot manufacture 40 of them. These are called the **essential nutrients** (see **Table 5.4**). Failure to obtain adequate amounts of any essential nutrient can result in weakness, ill health, or a deficiency disease such as goiter from lack of iodine. Inadequate intake of vitamin A is the most common cause of blindness in children worldwide.

TABLE 5.4	The Essential Nutrients*
------------------	---------------------------------

Amino Acids	Fats	Water	Vitamins	Minerals
Isoleucine	Linoleic acid		Ascorbic acid (vitamin C)	Calcium
Leucine	Linolenic acid		Biotin	Chlorine
Lysine			Cobalamin (vitamin B ₁₂)	Chromium
Methionine			Folic acid	Cobalt
Phenylalanine			Niacin (vitamin B ₃)	Copper
Threonine			Pantothenic acid	Iodine
Tryptophan			Pyridoxine (vitamin B ₆)	Iron
Valine			Riboflavin (vitamin B ₂)	Magnesium
Arginine [†]			Thiamine (vitamin B ₁)	Manganese
Histidine [†]			Vitamin A	Molybdenum
			Vitamin D	Phosphorus
			Vitamin E	Potassium
			Vitamin K	Selenium
				Sodium
				Sulfur
				Zinc

[†]Must be obtained from food.

[†]Not essential for adults; needed for growth in children.

Description

Researchers have determined the daily amount of the essential and other nutrients consistent with good health. Many countries and the World Health Organization have produced dietary recommendations based on this research. In the United States, these recommendations, called **Dietary Reference Intakes (DRIs)** are issued by the Food and Nutrition Board of the National Academy of Science's Institute of Medicine. DRIs are issued for men and women in reasonably good health, pregnant and lactating women, and children (**Table 5.5**). The DRIs are derived from the following measures.

TABLE 5.5 Examples of Daily Reference Intakes (DRIs)

Nutrient	Recommended Daily Intake
----------	--------------------------

Nutrient	Recommended Daily Intake	
	21-Year-Old Female*	21-Year-Old Male**
	21-Year-Old Female*	21-Year-Old Male**
Carbohydrate	277–400 g	319–461 g
Total fiber	25 g	38 g
Protein	47 g	60 g
Linoleic acid	Low with adequate diet	17 g
Saturated fatty acids	As low as possible while consuming a nutritionally adequate diet	
Dietary cholesterol	As low as possible while consuming a nutritionally adequate diet	
Total water***	2.7 L (about 11 cups)	3.7 L (about 16 cups)
Vitamin A	700 mcg	900 mcg
Vitamin C	75 mg	90 mg
Vitamin D	15 mcg	15 mcg
Vitamin B ₆	1 mg	1 mg
Vitamin E	15 mg	15 mg
Vitamin K	90 mcg	120 mcg
Vitamin B ₁₂	2 mcg	2 mcg
Thiamin	1 mg	1 mg
Riboflavin	1 mg	1 mg
Folate	400 mcg	400 mcg

Nutrient	Recommended Daily Intake	
	21-Year-Old Female*	21-Year-Old Male**
Niacin	14 mg	16 mg
Choline	425 mg	550 mg
Pantothenic acid	5 mg	5 mg
Biotin	30 mcg	30 mcg
Calcium	1,000 mg	1,000 mg
Chloride	2.3 g	2.3 g
Chromium	25 mcg	35 mcg
Copper	900 mcg	900 mcg
Fluoride	3 mg	4 mg
Iodine	150 mcg	150 mcg
Iron	18 mg	8 mg
Magnesium	310 mg	400 mg
Manganese	1.8 mg	1.8 mg
Molybdenum	45 mcg	45 mcg
Phosphorus	700 mg	700 mg
Potassium	4.7 g	4.7 g
Selenium	55 mcg	55 mcg
Sodium	1.5 g	1.5 g

Nutrient	Recommended Daily Intake	
	21-Year-Old Female*	21-Year-Old Male**
Zinc	11 mg	8 mg

g = gram; mcg = microgram; mg = milligram

*Female: height = 5 feet 5 inches, weight = 140 pounds, body mass index = 23.4, estimated energy requirement = 2,204 Cal/da

**Male: height = 5 feet 9 inches, weight = 165 pounds, body mass index = 24.5, estimated energy requirement = 2,835 Cal/da

***Total water = water from food, beverages, and drinking water

Nutrients not included in the table: carotenoids, arsenic, boron, nickel, silicon, sulfate, vanadium

U.S. Department of Agriculture, Interactive DRI for Health Professionals.

<https://www.nal.usda.gov/fnic/dri-calculator/>.

- **Recommended Dietary Allowance (RDA):** The average daily level of intake established by research that is sufficient to meet the nutrient requirements for 97% to 98% of healthy individuals.
- **Adequate Intake (AI):** The intake level of a nutrient estimated to ensure nutritional adequacy when scientific evidence is insufficient to state an RDA.
- **Tolerable Upper Intake Level (UL):** The daily amount of a nutrient above which the risk of adverse health effects occurs.
- **Estimated Average Requirement (EAR):** An amount of a nutrient that is estimated to meet the requirement of 50% of the healthy individuals in a group.

For almost all nutrients, the DRI is the basis for Daily Value (DV) on a commercial food's Nutrition Facts label.

Many Americans overconsume DRI amounts of sodium (salt) and saturated fat and underconsume DRI amounts of calcium, magnesium, vitamin A, vitamin C, vitamin D, vitamin E, folate, potassium, and fiber (U.S. Department of Agriculture, 2015). In addition, many pregnant women do not consumer sufficient iron. You can determine your personal DRI at the USDA website (<https://www.nal.usda.gov/fnic/interactiveDRI/>). You can see how your usual diet conforms to DRI recommendations by keeping a food diary and analyzing it with any of a number of food tracker apps.

Energy for Life

Besides providing the chemical constituents for life, food also provides energy to the body. The ultimate source of energy for complex organisms is sunlight, which is captured by green plants and converted to chemical energy that is stored as plant material. When humans eat plant matter or tissue from plant-eating animals, they obtain this stored chemical energy. Biological energy is used most efficiently when liberated in the presence of oxygen, which is one reason you breathe. In the process of extracting energy, the food material is converted to carbon dioxide, water, and other waste products and eliminated from the body in expired air, urine, feces, and sweat.

Energy transformations in living things are discussed in terms of calories. A **calorie** is the amount of heat energy required to raise 1 gram of water from 14.5 °C to 15.5 °C. A **nutritional calorie**, which is what weight watchers watch, is 1,000 calories, or a **kilocalorie**. Discussions of human nutrition and physical fitness frequently use the word *calorie* when actually referring to a kilocalorie. This textbook follows the same convention.



Power Up! Do Breakfast

Even if you get by on only a few hours of sleep, when you wake up it has still been 5, 10, or even more hours since you last ate. Your biological gas tank is nearly empty. If you're like many other students, as soon as you get out of bed you get ready to face the day and dash out the door without eating breakfast.

Yes, you could get a wake-up jolt from stopping en route for a pastry and a sweetened, caffeinated coffee drink. This is not the best option. In a couple of hours you'll be hungry because all that sugar got metabolized and you'll be drowsy from low blood sugar and the caffeine wearing off.

Better to start the day by powering up your body and mind with a few hundred calories of nutritious food so you can function maximally right out of the gate. It doesn't have to be a big, sit-down breakfast of OJ and bacon and eggs or pancakes and sausage, although that'll work. You can do fine with investing 10 minutes to gobble down a whole-grain food (oatmeal, whole wheat toast, or bagel), a piece of fruit or 100% juice (none of the sugary stuff), and some protein (milk or yogurt). If you can't find 10 minutes, then pack up some healthy items the night before and grab and go as you head out the door. That way you'll get the slow-release energy provided by the complex carbs in the whole-wheat foods and be better able to function physically, mentally, and emotionally to the max from the vitamins, minerals, and amino acids from the fruit and protein.

Nutrients can be grouped into seven categories: carbohydrates, fats, proteins, vitamins, minerals, phytochemicals, and water. Of these groups, fats and carbohydrates are the major forms of food energy. Fats provide 9 calories of energy per gram of fat, and carbohydrates provide 4 calories of energy per gram of carbohydrate. Although protein is capable of supplying 4 calories of energy per gram, its primary functions are to provide the body's architecture and to carry out maintenance functions. Virtually every cell in the body is capable of the series of chemical transformations necessary to extract chemical energy from these nutrient molecules. The biological process of deriving energy and obtaining material for the manufacture of cellular molecules is called **metabolism**.

Alcohol supplies about 7 calories per gram. This means a standard mixed drink, a beer, or a glass of wine has about 120 to 150 calories. Alcohol has no nutritional value. Consuming two to three drinks every day without a compensatory reduction in food calories or an increase in exercise can lead to an increase in body weight. Yes, a beer belly can actually be a beer belly.



Estimating Your Daily Calorie Needs

Step 1: What is your height?

I am _____ feet _____ inches tall.

Step 2: How many body mass units do you have?

Calculate them this way:

Women: Allow 100 body mass units for first 5 feet of height + 5 body mass units for each additional inch.

Men: Allow 106 body mass units for first 5 feet of height and 6 body mass units for each additional inch.

My total body mass units = _____

Step 3: What is your activity factor?

Sedentary = 13

Active = 15

Very active = 17

Step 4: What is your estimated daily calorie need?

Multiply your body mass units by your activity factor = _____

Energy is needed to support three major processes: (1) *basal* (or resting) metabolism, which is the energy required to keep the body alive; (2) *physical activity*, the things you do when you're not completely at rest; and (3) *growth and repair*. The energy to support **basal metabolism** keeps cells functioning, maintains the body temperature within its normal limits, and keeps the heart, lungs, kidneys, and other internal organs functioning. The daily amount of energy required to support basal metabolism is called the **basal metabolic rate (BMR)**, or resting metabolic rate. The BMR for adult women is about 1,100 calories per day; for adult men, it is about 1,300 calories per day.

In addition to the energy you need for basal metabolism, you use energy in physical activity: walking, running, working, and so on. The amount of energy expended for these activities depends on how strenuous the activity is, how long it is engaged in, the body's size, and the environmental temperature. It takes more energy to be

active in hot weather than in moderate temperatures, and it takes more energy to maintain body temperature when the weather is cold.

Energy is also needed whenever the body produces more cells than are needed to replace ones that periodically die. Thus, all young people need additional energy for growth. Energy is also needed to produce new cells to repair wounds and injuries.

Energy requirements for individuals vary, depending on body size and composition, physical activity, growth needs during adolescence and young adulthood, pregnancy or breastfeeding status, injury repair, and coping with illness. The DRI for adult American men is about 2,800 calories per day; for nonpregnant, nonlactating adult American women, it is about 2,300. Nutritionists recommend that carbohydrates from whole grains, vegetables, and fruits be the principal source of energy, supplying about 50% of total calories consumed. Healthy fats should make up no more than 30% of total calories consumed. Protein is generally not recommended as a source of energy but only as a source of building blocks for the body's tissues and organs.



Natural, unprocessed foods provide the best nutrition.

© Michael Lamotte/Cole Group/Photodisc/Getty Images

People who are interested in weight management need to keep in mind that a large percentage of daily energy is required just to stay alive. That's why cutting back on food (energy) is a limited and generally unsuccessful strategy for weight management. All successful weight management focuses on the physical activity portion of energy use. That's something you can increase that will consume energy without affecting basic life functions.

Pleasures of Eating

Everyone has experienced the feeling of hunger and its appeasement by eating something. But hunger is not the only reason for eating. Most of the time we eat because it is "time to eat," because we have been presented with food, because it feels good to be eating something—especially something fatty or sweet—or because eating is an enjoyable social ritual. The ready availability of food is unique to modern societies; a hundred years ago there were no supermarkets, fast-food restaurants, or convenience stores on every block. Thus, we are able to consume food for a variety of reasons. Also, advertising encourages us to eat more, and often products that aren't particularly healthy.

The Seven Components of Food

Food is composed of seven kinds of chemical substances: proteins, carbohydrates, lipids (fats), vitamins, minerals, phytochemicals, and water. Dietary proteins, most types of carbohydrates, and most lipids cannot be used by the body until they are broken down in the digestive system into smaller chemical units (**Figure 5.7**). In fact, only vitamins, minerals, a few kinds of carbohydrates, phytochemicals, and water are absorbed into the body as is.

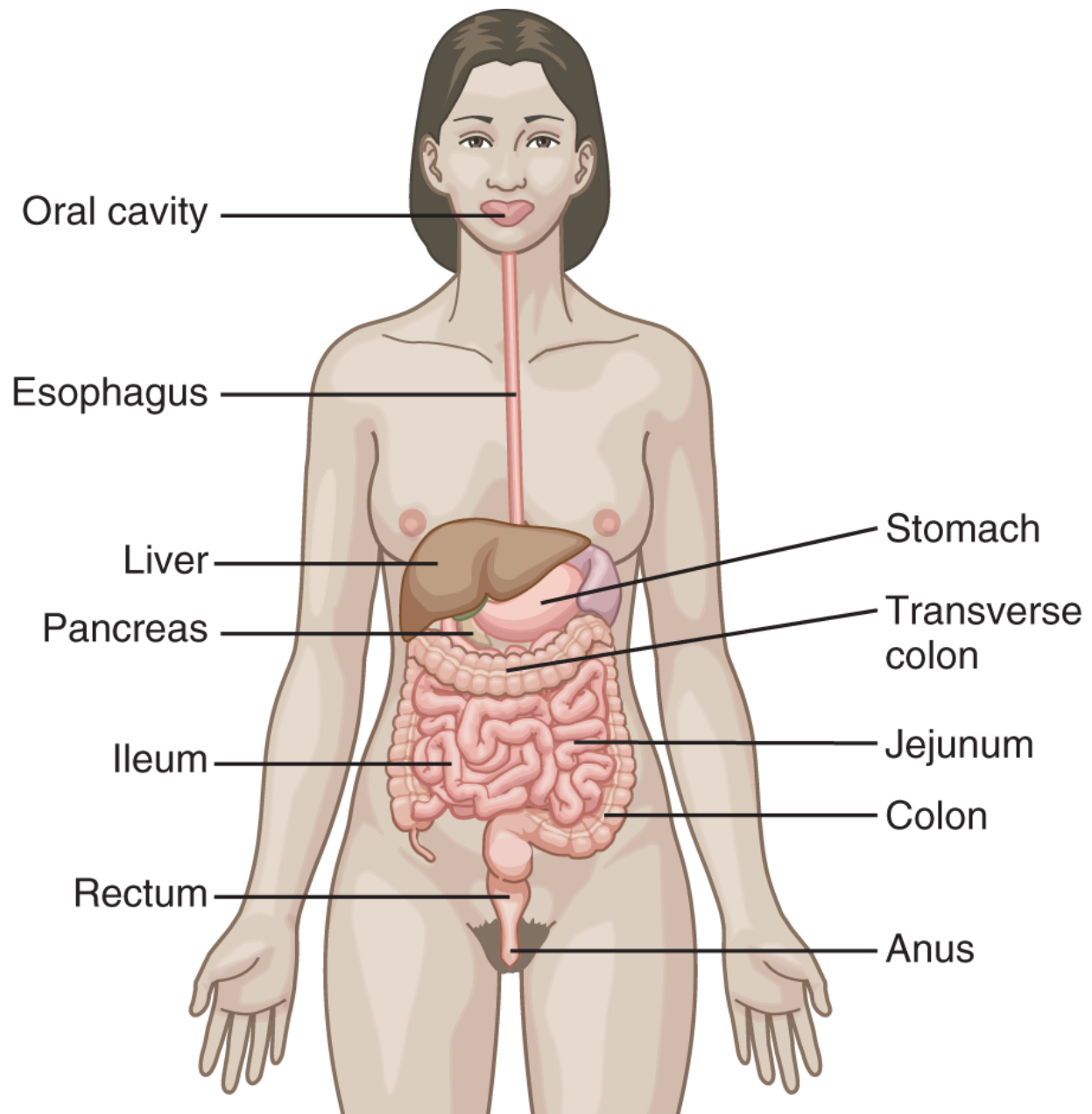


Figure 5.7 Human Digestive System. Teeth and glandular secretions in the mouth help break up food, which the esophagus transports to the stomach. The stomach breaks down some of the food molecules and passes the food to the rest of the digestive tube: the duodenum, jejunum, ileum, colon, and rectum. The pancreas secretes enzymes and fluid into the duodenum to help the digestive process. The liver controls the release of absorbed nutrients into the body. Undigested material is eliminated from the body at the anus.

Description

Proteins

About 20% of your body mass is protein. Much of the body's structural components and many of its vital functions are carried out by proteins.

Proteins are made up of chemical units called **amino acids**, which come in 20 different forms. Amino acids are classified as *essential* and *nonessential*. Adults require eight **essential amino acids**; those eight and two others are required by infants. Animal sources of protein include milk and milk products, meat, fish, poultry, and eggs. Plant sources include breads and cereal products, legumes, nuts, and seeds. The body can transform essential amino acids to nonessential ones as needed.

Amino acids are not stored in the body in any appreciable amounts; therefore, proper nutrition requires eating enough high-quality protein just about every day to meet the body's needs for essential amino acids. The recommended consumption of protein for adult women is 46 grams per day and adult men about 55 grams. A hamburger patty has about 20 grams of protein. The average North American adult consumes about twice the recommended amount; the unneeded protein is broken down by the body and excreted in urine or stored as fat.

Because the amino acid composition of most animal protein is similar, people tend to acquire adequate amounts and proportions of the essential amino acids from animal tissue, such as fish, meat, eggs, and dairy products. Most vegetable proteins, however, are deficient in one or more of the essential amino acids, so individuals who eat little or no meat or dairy products must eat foods in which an amino acid deficiency in one food is compensated for by an amino acid surplus in another. For example, wheat, rice, and oats contain little of the essential amino acid lysine but have large amounts of the essential amino acids methionine and tryptophan. Soybeans and other legumes are relatively high in lysine but are low in methionine and tryptophan. Meals consisting of both grains and legumes (e.g., rice and beans, corn and beans, wheat and soybeans) can supply adequate amounts of these essential amino acids. **Protein**

complementarity is the practice of combining sources of protein such that amino acid deficiencies in one source are counterbalanced, or *complemented*, by abundances in another source.

Meat, dairy products, and eggs provide the essential amino acids, but they can be high in saturated fat and thus contribute to heart disease, cancer, and other saturated fat-related health problems. For this reason, nutritionists recommend consuming nonfat or low-fat dairy products, using butter as a spread and not as an ingredient for cooking, and being mindful of the amount of ice cream eaten. Nutritionists also favor trimming fat from meat before cooking, selecting meat with a low-fat content, and eating poultry (with skin removed because it contains fat) and fish, which have proportionately less fat than red meats. They also recommend using meat sparingly by adding it to grain- or bean-based dishes, rather than making it the center of the meal.



Ramen, a Japanese dish that consists of wheat noodles, is a healthy alternative to eating fatty fast food.

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A small but measurable association has been found between the regular consumption of red meat and the risk of heart disease and cancer (Zeraatkaer et al., 2019). There is a larger association of consuming processed meats with the risk of a variety of diseases. Consuming fish or chicken does not increase the risk of heart die or cancer. Red meat includes beef, veal, pork, lamb, mutton, horse, and goat. *Processed meat* refers to meat that has been transformed through salting, curing, fermentation, smoking, or other methods to enhance flavor or improve preservation. Most processed meats contain pork or beef; some may contain other red meats, poultry, offal, or meat by-products, such as blood. Examples of processed meat include hot dogs (frankfurters), ham, sausages, corned beef, and biltong or beef jerky, as well as canned meat and meat-based preparations and sauces. Consumers are advised to cut back on the amount of red meat by using it as a side dish instead of the center piece of a meal and to forgo eating processed meats altogether (Harvard Men's Health Watch, 2020).

Scientists do not know the reasons for the observed association of red meat and processed meat consumption and disease but offer the following plausible explanations: (1) Cooking (especially charring) meat can produce cancer-causing agents called *heterocyclic amines* that harm the colon; (2) when red and processed meats are at the center of the diet, they replace vegetables and legumes (beans), so the variety of healthful nutrients found in plants is not consumed; (3) bacteria naturally found in the gastrointestinal tract (the microbiome) can harm gut tissues; (4) nitrates and nitrate chemicals called *N-nitroso compounds*, which are used as preservatives in processed meats can damage DNA in colon cells. Besides increasing the risk of heart disease and cancer, red meat is the vector for *spongiform encephalopathy* (mad cow disease) and other foodborne illnesses. High-intensity meat production also is detrimental to the

environment. The production of 1 pound of meat requires 15,000 to 20,000 gallons of water. Cattle are fed corn and soy, the excessive production of which degrades the land and introduces pesticides into the food supply. The methane produced by cattle digestive processes and emitted into the air contributes significantly to global warming.

Vegetables aren't my meat and potatoes.

—Yogi Berra

Athletes are often encouraged to consume more than the DRI of protein to increase endurance, body strength, and repair of injury, with emphasis on benefits from consuming protein around the time of muscular exertion. For athletes, the American College of Sports Medicine and the Academy of Nutrition and Dietetics of Canada (Thomas, Erdman, & Burke, 2016) recommend intakes of 1.2 to 2.0 grams of high-quality protein per kilogram of body weight consumed on days of strenuous training and activity and on the day after(. That protein can come from lean meat, fish, poultry, eggs, vegetables, grains, beans, and dairy. It is not necessary to consume protein powders or high-protein liquids. Regular food will do.

Carbohydrates

Carbohydrates are a major source of food energy and also are used to manufacture some cell components, such as the hereditary material *deoxyribonucleic acid* (DNA). Because the body can manufacture them from other substances, carbohydrates are not considered essential nutrients.

Most animals have a “sweet tooth” to motivate consumption of carbohydrates, and humans are no exception. That’s why food manufacturers often add sugars and other sweeteners (such as high-fructose corn syrup to their products. Indeed, about 70% of packaged food products in the United States and Canada contain

added sugar (Popkin & Hawkes, 2016). Because added sugar provides calories but no essential nutrients, sugar is usually described as contributing “empty calories” to the diet. Excess calories from added sugar are converted to body fat, which may contribute to overweight and obesity, heart disease, and diabetes. Excess sugar in the diet also contributes to tooth decay.

The average American adult consumes about 80 grams of added sugar per day. The American Heart Association recommends that adult men consume no more than 38 grams of added sugar per day and adult women and teens no more than 25 grams. A 12-ounce soda contains 46 grams of added sugar; a 16-ounce bottle of sweet tea contains 50 grams. A serving of bottled spaghetti sauce contains 12 grams. A 12 ounce can of an energy drink has 25–30 grams of added sugar.

The Nutrition Facts panel on a manufactured food product lists as “sugar” both the sugar that occurs naturally in the food and the sugar added by the manufacturer. A product’s ingredients label lists all the forms of added sugar but not how much of each (**Figure 5.8**). The amount of added sugar requires consulting websites that list such values.

Agave nectar	Date sugar	Molasses
Barbados sugar	Dehydrated cane juice	Muscovado
Barley malt	Demerara sugar	Palm sugar
Barley malt syrup	Dextrin	Panocha
Beet sugar	Dextrose	Powdered sugar
Brown sugar	Fructose	Raw sugar
Buttered syrup	Fruit juice concentrate	Refiner's syrup
Cane juice	Glucose	Rice syrup
Cane juice crystals	HFCS (high-fructose corn syrup)	Saccharose
Cane sugar	Honey	Sorghum syrup
Caramel	Icing sugar	Sucrose
Carob syrup	Invert sugar	Sugar (granulated)
Caster sugar	Malt sugar	Sweet sorghum
Coconut palm sugar	Maltodextrin	Syrup
Coconut sugar	Maltol	Treacle
Confectioner's sugar	Maltose	Turbinado sugar
Corn sweetener	Mannose	Yellow sugar
Corn syrup	Maple syrup	
Corn syrup solids		

Figure 5.8 Names for Sugars Added to Commercial Foods.

Description

Simple Sugars

There are two principal types of carbohydrates: **simple sugars**, which are found predominantly in fruit; and complex carbohydrates, which are found in grains, fruit, and the stems, leaves, and roots of vegetables.

Glucose is the most common simple sugar; it is found in all plants and animals. Glucose circulates in the bloodstream and is commonly referred to as *blood sugar*. Another simple sugar is **fructose**, which is found in fruits and honey. Fructose is one of the sweetest sugars, which means you can eat less fructose than other simple sugars and taste an equivalent amount of sweetness.

Sucrose, which is common table sugar (the *refined* sugar added to many packaged foods), is a combination of glucose and fructose. Sucrose is digested by breaking apart the glucose and fructose

portions. Because fructose is sweeter than sucrose, you can reduce the amount of sugar in your diet without cutting out sweet tastes by replacing pastries with fresh fruit and table sugar with honey. Besides more sweet taste, you will be gaining other nutrients in the fruit and honey that are not present in refined sucrose.



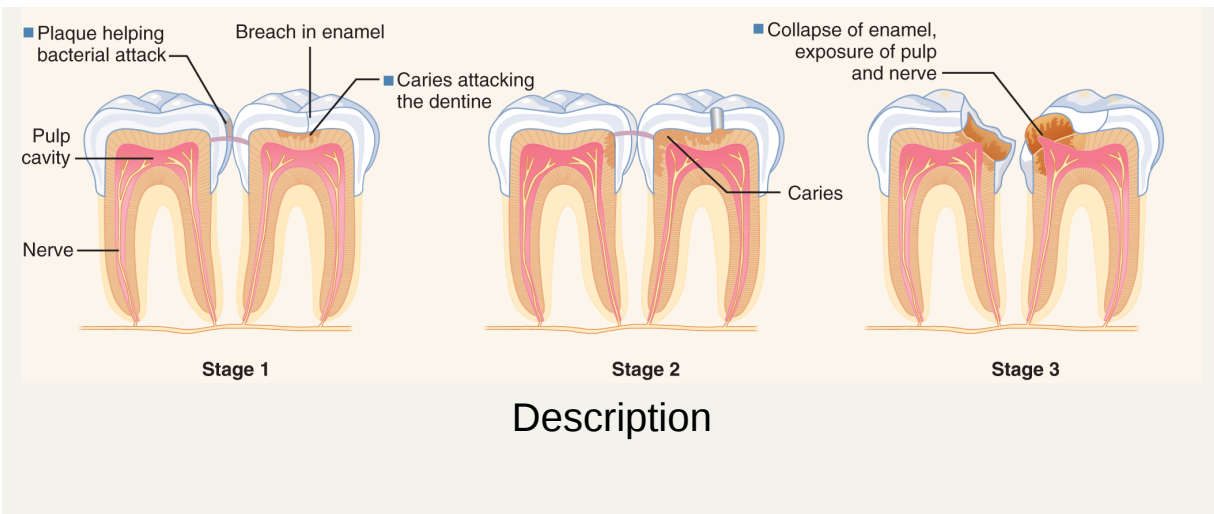
Taking Care of Your Teeth and Gums

Taking care of your teeth and gums means adopting practices for oral health that prevent tooth decay (dental caries) and gum disease (gingivitis and periodontitis). Tooth decay and gum disease are caused by the action of a variety of bacteria that live in the mouth, which produce acids by breaking down the sugars in food. The acids attack the enamel of teeth, causing tooth decay. Other bacteria are involved in the conversion of sugars and some of the material in saliva into a gelatinous substance called *plaque*, which sticks to teeth and gums and fosters more bacterial growth and decay.

Tooth and gum disease could be prevented if (1) the bacteria responsible could be removed from the mouth, (2) the sugars and other substances bacteria use to produce acids and plaque were removed from the mouth, or (3) teeth were protected from the bacterial products.

It is not yet possible to keep all tooth and gum disease–causing bacteria from the mouth or to render them harmless. So, keeping the mouth free of sugar and plaque is the best way to prevent tooth and gum problems. You can accomplish this by doing the following:

- not eating sugar and sugar-containing foods between meals;
- consuming sweets in liquid rather than solid form when possible;
- avoiding sticky or slowly dissolving sweets;
- brushing teeth after each meal;
- rinsing the mouth with warm water when unable to brush after a snack or meal;
- obtaining fluoride (to increase resistance to tooth decay) from toothpastes, mouthwashes, and drinking water; and
- getting periodic dental checkups.



Lactose, a sugar found principally in milk and milk products, is made of the simple sugars glucose and galactose joined together. To free the glucose and galactose parts to provide energy for growth and development, lactose is broken apart in the digestive systems of nearly all babies by a protein called **lactase**. Following the genetic blueprint of early humans who did not domesticate cattle for milk production, in many peoples of the modern world the genes responsible for making lactase in early life are permanently switched off in older children and adults (University of California, Berkeley, 2007). When these individuals consume milk, cream, ice cream, or other milk products, they experience gastrointestinal upset, diarrhea, and, occasionally, severe illness. These individuals can supplement their diets with products containing lactase (e.g., Lactaid) or by eating yogurt, cheese, and other dairy products in which the lactose has been broken down by the fermentation process. Because dairy products are a major source of calcium in the North American diet, people who avoid dairy products should consume calcium-rich vegetables (e.g., broccoli and peas), calcium-fortified foods, and possibly take calcium supplements.

Complex Carbohydrates

Complex carbohydrates come primarily from grains (wheat, rice, corn, oats, barley); legumes (peas, beans); the leaves, stems, and

roots of plants; and some animal tissue. There are two main classes of complex carbohydrates: *starch*, which is digestible, and *fiber*, which is not digestible.

Starch consists of many glucose molecules linked together. It is a way organisms store glucose efficiently until it is needed. In plants, starch is usually contained in granules within seeds, pods, or roots. Wheat flour, for example, is made by crushing wheat grain, which separates the outer husk (the bran) from the middle, starch-containing portion (the endosperm) and the inner germ. The white flour commonly used in baking is “70% extraction,” which means that 70% of the original grain remains after crushing. In the milling of 70% extraction flour, many nutrients in the wheat grain are lost, so flour manufacturers add back several vitamins and minerals to produce *enriched flour*. A *whole-grain flour*, on the other hand, is 90% to 95% extraction and does not have to be enriched. Bread made with whole-wheat flour is brown, but not all brown bread is whole-wheat bread because some manufacturers add molasses or honey to white-flour dough to give it a brown color. **Gluten** is a mixture of proteins that occur naturally in wheat, rye, barley, and crossbreeds of these grains. Several million people in North America and many more in the world can become ill when they consume gluten either because of a genetic predisposition to a condition called *celiac disease* or some other gluten-related condition that damages the lining of the small intestine. Without a healthy intestinal lining, the body cannot absorb needed nutrients, possibly resulting in anemia (a lower-than-normal number of red blood cells), growth retardation, infertility, miscarriages, short stature, osteoporosis (a disease in which bones become fragile and more likely to break), diabetes, autoimmune thyroid disease, and intestinal cancers. To aid consumers who are at risk for gluten-related illness, the words *gluten free* on a food label or restaurant menu mean it has less than 20 parts per million of gluten. Keep in mind that *gluten free* does not necessarily mean healthier for people who are not sensitive to gluten. A gluten-free food product can still lack nutrients.

Starch is also found in potatoes, which have an undeserved reputation for being fattening. Potatoes are no more fattening than

any other starchy food unless they are cooked in large amounts of fat or oil, the process used to make french fries and potato chips. One large potato has about 100 calories, less than a medium-sized soft drink. French fries made from a medium potato, however, contain more than 300 calories.

Animals and humans produce a starch in muscle and liver tissue called **glycogen**. When energy is needed, the glycogen breaks down and its constituent glucose molecules are liberated. Athletes sometimes eat large quantities of carbohydrates the day before competition to build up their supply of glycogen, a practice known as *carbohydrate loading*.

Fiber is the second main class of complex carbohydrates. There are two kinds of fiber: **insoluble fiber**, which cannot dissolve in water, and **soluble fiber**, which can. Insoluble fiber is made up of **cellulose** and **hemicellulose**, substances that offer rigidity to plant material (wood; stems; the outer coverings of nuts, seeds, grains; the peels and skins of fruits and vegetables). Soluble fiber is composed of pectins, gums, and mucilages. The differences in insoluble and soluble fiber are not significant for health. Nutritionists recommend that individuals consume 20 to 35 grams of fiber daily, regardless of its type (**Table 5.6**).

TABLE 5.6 Fiber Content of Various Foods		
Food	Amount	Fiber (g)
Whole-wheat bread	1 slice	1.6
Rye bread	1 slice	1.0
White bread	1 slice	0.6
Brown rice (cooked)	½ cup	2.4
White rice (cooked)	½ cup	0.1

Food	Amount	Fiber (g)
Spaghetti (cooked)	½ cup	0.8
Kidney beans (cooked)	½ cup	5.8
Lima beans (cooked)	½ cup	4.9
Potato (baked)	Medium	3.8
Corn	½ cup	3.9
Spinach	½ cup	2.0
Lettuce	½ cup	0.3
Strawberries	¾ cup	2.0
Banana	Medium	2.0
Apple (with skin)	Medium	2.6
Orange	Small	1.2

Extensive data for fiber in foods:

Data from Dietary Fiber Chart:

<http://www.wehealny.org/healthinfo/dietaryfiber/fibercontentchart.html>

Fiber Content Calculator: http://www.globalrph.com/fiber_content.htm

USDA Nutritional Data Lab: <http://www.nal.usda.gov/fnic/foodcomp/search/>

Fiber adds bulk to the feces, thereby preventing constipation and related disorders such as hemorrhoids and hiatal hernias, which can result from prolonged increase in intraabdominal pressure while defecating. Fiber also facilitates the transport of waste material through the digestive tract, lessening the risk of appendicitis, diverticular disease (out pockets in the wall of the lower intestine), and cancer of the colon and rectum. High-fiber diets may also help to lessen the risk of heart disease and some cancers.



The Paleo Diet

Humans have come a long way since the Paleolithic Period or Old Stone Age 2–3 million years ago. Back then, people had to eat whatever they could gather and catch in their surroundings. Now, thanks to the efforts of thousands of food scientists, engineers, distributors, and marketers, the modern ancestors of paleolithic people can walk down supermarket aisles and acquire any manner of consumable chemical concoctions to support their lives.

Despite its variety and convenience, many modern humans have noted that the modern Western diet is associated with considerable illness, disability, and death; in response, they have tried to adopt a presumably healthier diet akin to what they believe was characteristic of early humans, referred to as the *paleolithic*, *cave man*, or *stone age diet*. Based on scientific studies of the remains of ancient humans, the Paleo Diet is based on the consumption of plant material (roots, nuts, seeds, wild grains, and eggs) and small, capturable animals (birds, rodents, fish, shellfish, and insects). Dairy products, cereal grains, legumes, refined fats, extra salt, and sugar are excluded. One need not be an anthropologist or a nutritionist to see that the content of the Paleo Diet is highly similar to modern healthy diet recommendations such as the DASH and Mediterranean Diets. Some comparison studies even show the Paleo Diet to be similar healthwise to modern healthy diet plans, probably because dairy products, added salt and sugars, and refined grains simply were not available to people 2.5 millions years ago (Jamka et al., 2020). Retro Paleo may be the way to go.

Because they contain complex carbohydrates, fiber, vitamins, and other nutrients, whole-grain foods are superior to manufactured and restaurant foods composed of refined grains (**Table 5.7**). Moreover, consumption of foods made of refined flour, which are nutritionally inferior, means that healthy whole-grain foods will not be consumed.

TABLE 5.7 **Whole-Grain and Refined-Grain Foods**

Whole-Grain Foods	Refined-Grain Foods
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Whole-Grain Foods	Refined-Grain Foods
Brown rice Buckwheat Bulgur (cracked wheat) Oatmeal Popcorn Ready-to-eat breakfast cereals Whole-wheat cereal flakes Muesli Whole-grain barley Whole-grain cornmeal Whole rye Whole-wheat bread Whole-wheat crackers Whole-wheat pasta Whole-wheat sandwich buns and rolls Whole-wheat tortillas Wild rice	Cornbread* Corn tortillas* Couscous* Crackers* Flour tortillas Grits Pasta* Noodles* Spaghetti Macaroni Pitas* Pretzels Ready-to-eat breakfast cereals Corn flakes White bread White sandwich buns and rolls White rice
Less Common Whole Grains	
Amaranth	
Millet	
Quinoa	
Sorghum	
Triticale	

Note: Whole-grain foods contain the entire grain kernel: bran, germ, and endosperm. Refined-grain foods are foods in which the bran and germ are removed to produce a finer texture and longer shelf life; the refining process removes fiber, iron, and many B vitamins. Most refined grains are enriched; certain B vitamins (thiamin, riboflavin, niacin, folic acid) and iron are added back after processing. Fiber is not added back. Some food products are made from mixtures of whole grains and refined grains. Some grain products contain significant amounts of bran. Bran provides fiber, which is important for health. However, products with added bran or bran alone (e.g., oat bran) are not necessarily whole-grain products.

*Most of these products are made from refined grains. Some are made from whole grains. Check the ingredients list for the words “whole grain” or “whole wheat” to decide if they are made from a whole grain. Some foods are made from a mixture of whole and refined grains. U.S. Department of Agriculture. (2017). What foods are in the grains group? Retrieved from <http://www.choosemyplate.gov/grains>

Some foods contain fortified or functional fiber (sometimes referred to as *fake fiber*), which is not actual plant fiber but chemicals extracted from plants or manufactured in factories. Manufacturers add these substances to their food products to augment sales by making “high-fiber” claims. Generally, functional fiber is found in highly processed foods such as white bread, yogurt, ice cream, sugary cereals, energy bars, and even juices and waters. Even though it has little nutritive value, functional fiber can be counted in the total fiber listed on the Nutrition Facts label and listed on the product’s ingredients label as inulin, pectin, polydextrose, methylcellulose, or maltodextrin. Examples of natural fiber listed on the ingredients label are wheat bran, corn bran, and oats.

Lipids (Fats)

Lipids are a diverse group of substances that have the common chemical property of not readily mixing or dissolving in water. Some of these substances include cholesterol and **lecithin**, which are essential constituents of cell membranes; the steroid hormones produced by the reproductive organs and adrenal glands; vitamins A, D, E, and K; and bile acids, which aid the digestion of fats. Despite the current antifat trend, lipids are an essential part of the diet. They supply calories, provide flavor and texture to food, and during digestion provide feelings of satiety and well-being. One kind of fat, **linoleic acid**, found in vegetable oils such as safflower, sunflower, and corn, is essential, and must be obtained in food. Deficiencies in this substance can produce skin lesions and immune system malfunctions.

Much of the fat consumed in the diet is **triglyceride**, which is composed of **fatty acids**. These substances are further classified as saturated, monounsaturated, or polyunsaturated, depending on their

chemistry. *Saturation* refers to the number of hydrogen atoms (and therefore the amount of energy) contained in a fatty acid. A saturated fatty acid carries all the hydrogen atoms it can. A **monounsaturated fatty acid (MUFA)** carries one fewer hydrogen atoms than it possibly could carry. A **polyunsaturated fatty acid** lacks two or more hydrogen atoms. A dietary fat is classified as saturated, monounsaturated, or polyunsaturated, depending on the type of fatty acids it contains in greatest quantity.

Saturated fats are found in whole milk and products made from whole milk, egg yolks, meat, meat fat, coconut and palm oils, chocolate, regular margarine, and hydrogenated vegetable shortenings. Sources of monounsaturated fats include olive oil and some nuts. Polyunsaturated fats are found in safflower, cottonseed, corn, soybean, and sesame seed oils, and fatty fish (**Figure 5.9**).



Figure 5.9 Unhealthy and Healthy Fats. Trans and saturated fats in fast and packaged food are less healthy than polyunsaturated fats found in fish, nuts, and vegetable oils.

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Diets high in saturated fat increase the risk of heart disease, some cancers, and overweight. Dietary guidelines recommend that adults' total fat intake be 10% or less of total calories. Conversely, polyunsaturated fats tend to lessen the risk of heart and blood vessel disease, which is why nutritionists recommend consuming vegetable oils, nuts, and fish.

Food manufacturers and restaurants sometimes use chemicals derived from vegetable oils called **trans fatty acids**, trans fats or, *partially hydrogenated vegetable oils* (PHVOs). Because trans fats are unhealthy, the United States, Canada, and many countries have legally banned PHVOs from their food supplies. Certain trans fats are components of natural foods, however, and because some manufacturers use them in small quantities, the total amount of trans fat is listed on a product's Nutrition Facts label.

Fat substitutes (e.g., Simplese) are chemicals added primarily to packaged pastries, snack foods, sour cream, yogurt, and salad dressings to provide the taste and texture of fat without contributing calories. The purported benefit of fat substitutes—that they contribute to weight management—apparently is overstated because consumers tend to compensate for the lack of energy derived from fat by ingesting greater amounts of carbohydrates.

Vitamins

Vitamins are substances that facilitate a variety of biological processes. Vitamins do not provide building blocks for the manufacture of the body's tissues nor do they provide calories to fuel the body's functions. Instead, like workers on an assembly line, they carry out the same tasks over and over again until they wear out and need to be replaced. This is why the body requires much smaller amounts of vitamins than it does proteins, carbohydrates, and fats.

The body requires 13 essential vitamins; they must be obtained from food (**Table 5.8**). Vitamins are classified as **water-soluble** or **fat-soluble**, depending on their chemistry.

TABLE 5.8	Water-Soluble and Fat-Soluble Vitamins
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Water-Soluble Vitamin	Why Needed?	Primary Sources	Deficiency Results In
Ascorbic acid (vitamin C)	Tooth and bone formation; production of connective tissue; promotion of wound healing; may enhance immunity	Citrus fruits, tomatoes, peppers, cabbage, potatoes, melons	Scurvy (degeneration of bones, teeth, and gums)
Biotin	Involved in fat and amino acid synthesis and breakdown	Yeast, liver, milk, most vegetables, bananas, grapefruit	Skin problems; fatigue; muscle pains; nausea
Cobalamin (vitamin B ₁₂)	Involved in single carbon atom transfers; essential for DNA synthesis	Muscle meats, eggs, milk, and dairy products (not in vegetables)	Pernicious anemia; nervous system malfunctions
Folacin (folic acid)	Essential for synthesis of DNA and other molecules	Green leafy vegetables, organ meats, whole-wheat products	Anemia; diarrhea and other gastrointestinal problems
Niacin	Involved in energy production and synthesis of cell molecules	Grains, meats, legumes	Pellagra (skin, gastrointestinal, and mental disorders)
Pantothenic acid	Involved in energy production and synthesis and breakdown of many biological molecules	Yeast, meats and fish, nearly all vegetables and fruits	Vomiting; abdominal cramps; malaise; insomnia
Pyridoxine (vitamin B ₆)	Essential for synthesis and breakdown of amino acids and manufacture of unsaturated fats from saturated fats	Meats, whole grains, most vegetables	Weakness; irritability; trouble sleeping and walking; skin problems
Riboflavin (vitamin B ₂)	Involved in energy production; important for health of the eyes	Milk and dairy foods, meats, eggs, vegetables, grains	Eye and skin problems
Thiamin (vitamin B ₁)	Essential for breakdown of food molecules and production of energy	Meats, legumes, grains, some vegetables	Beri-beri (nerve damage, weakness, heart failure)
Fat-Soluble Vitamin	Why Needed?	Primary Sources	Deficiency or Excess Results In
Vitamin A (retinol)	Essential for maintenance of eyes and skin; influences bone and tooth formation	Liver, kidney, yellow and green leafy vegetables, apricots	Deficiency: night blindness; eye damage; skin dryness. Excess: loss of appetite; skin problems; swelling of ankles and feet
Vitamin D (calciferol)	Regulates calcium metabolism; important for growth of bones and teeth	Cod liver oil, dairy products, eggs	Deficiency: rickets (bone deformities) in children; bone destruction in adults. Excess: thirst; nausea; weight loss; kidney damage
Vitamin E (tocopherol)	Prevents damage to cells from oxidation; prevents red blood cell destruction	Wheat germ, vegetable oils, vegetables, egg yolk, nuts	Deficiency: anemia, possibly nerve cell destruction
Vitamin K (phyloquinone)	Helps with blood clotting	Liver, vegetable oils, green leafy vegetables, tomatoes	Deficiency: severe bleeding

Description Description

Vitamins A (and its dietary precursor, beta-carotene), C, and E are classed as **antioxidants** because they have the capacity to neutralize the effects of chemicals called *free radicals*, which can damage biological structures via chemical oxidation. Antioxidant vitamins are found in a variety of fruits and vegetables (not beans) and can be obtained in vitamin supplements. People who consume foods containing large amounts of antioxidant vitamins have less risk of cancer, heart disease, and cataracts than people who consume small amounts. However, in laboratory studies, taking vitamins C, E, and beta-carotene have not been shown to prevent cancer or cataracts and may be harmful in large doses. This illustrates (once again) that healthy nutrition is a matter of consuming whole, fresh foods rather than large amounts of individual nutrients.

Folic acid (also called *folate* or *folacin*), a vitamin found in dark-green leafy vegetables, beans, and fruits, helps prevent spina bifida and other neural tube defects in babies. Most American women consume an adequate amount of folate in their diets (about 400 micrograms per day). However, increasing to 600 micrograms per day is recommended for women who intend to become pregnant or are pregnant. To ensure people, especially the elderly, receive adequate folate in their diets, the federal government requires that manufacturers of cereal-based foods (e.g., breads, breakfast cereals, pastas) fortify their products with it.

Some people are deficient in vitamin D, which is made in the skin in response to sunlight. People who live in northern or southern latitudes, who have dark skin, or who remain indoors for most of the day are most at risk for low levels of vitamin D. Vitamin D helps the body absorb and retain calcium and phosphorus, thus fostering strong bones and teeth. Vitamin D also helps maintain muscle strength, especially in the elderly. It enables the body to fight infections and some cancers, and it may lessen the risk of heart disease. Adequate levels of vitamin D can be obtained in light-skinned individuals through 15 minutes' exposure to midday sun; dark-skinned individuals may require more sun exposure. Most foods are naturally low in vitamin D, but adequate amounts can be

obtained from food fortified with vitamin D or from vitamin D supplements.

Minerals

Many body functions require one or more inorganic elements called **minerals** (Table 5.9). Sodium, potassium, and chlorine, for example, are minerals. They are essential for maintaining cell membranes, conducting nerve impulses, and contracting muscles. Magnesium, copper, and cobalt facilitate certain biochemical reactions; iron is essential for the oxygen-carrying function of hemoglobin; iodine is needed to produce thyroid hormone; and calcium and phosphorus make up bones and teeth. Selenium may reduce the risk of cancer, perhaps because of its activity as an antioxidant.

TABLE 5.9	Essential Minerals
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Mineral	Why Needed?	Primary Sources	Results from Deficiency
Calcium	Bone and tooth formation; blood clotting; nerve transmission	Milk, cheese, dark-green vegetables, dried legumes	Stunted growth; rickets; osteoporosis; convulsions
Chlorine	Formation of gastric juice; acid-base balance	Common salt	Muscle cramps; mental apathy; reduced appetite
Chromium	Glucose and energy metabolism	Fats, vegetable oils, meats	Impaired ability to metabolize glucose
Cobalt	Constituent of vitamin B ₁₂	Organ and muscle meats	Not reported in humans
Copper	Constituent of enzymes of iron metabolism	Meats, drinking water	Anemia (rare)
Iodine	Constituent of thyroid hormones	Marine fish and shellfish, dairy products, many vegetables	Goiter (enlarged thyroid)
Iron	Constituent of hemoglobin and enzymes of energy metabolism	Eggs, lean meats, legumes, whole grains, green leafy vegetables	Iron-deficiency anemia (weakness, reduced resistance to infection)
Magnesium	Activates enzymes; involved in protein synthesis	Whole grains, green leafy vegetables	Growth failure; behavioral disturbances; weakness, spasms
Manganese	Constituent of enzymes involved in fat synthesis	Widely distributed in foods	In animals: disturbances of nervous system, reproductive abnormalities
Molybdenum	Constituent of some enzymes	Legumes, cereals, organ meats	Not reported in humans
Phosphorus	Bone and tooth formation; acid-base balance	Milk, cheese, meat, poultry, grains	Weakness; demineralization of bone
Potassium	Acid-base balance; body water balance; nerve function	Meats, milk, many fruits	Muscular weakness; paralysis
Selenium	Functions in close association with vitamin E	Seafood, meat, grains	Anemia (rare)
Sodium	Acid-base balance; body water balance; nerve function	Common salt	Muscle cramps; mental apathy; reduced appetite
Sulfur	Constituent of active tissue compounds, cartilage, and tendon	Sulfur amino acids (methionine and cysteine) in dietary proteins	Related to intake and deficiency of sulfur amino acids
Zinc	Constituent of enzymes involved in digestion	Widely distributed in foods	Growth failure

Description

Minerals are found in most foods, especially fresh vegetables. Women and young people are susceptible to iron deficiency, so they must eat iron-rich foods, such as eggs, lean meats, brans, whole grains, and green leafy vegetables. Most women and elderly people ingest too little calcium, which is found in dairy products and some green leafy vegetables such as broccoli and turnip greens ([Table](#)

5.10). Because sodas tend to replace milk—and therefore calcium—in many people’s diets, nutritionists recommend that soda consumption be limited (if not eliminated) in the diets of children and adolescents to strengthen bones in both early and later life.

TABLE 5.10 Calcium in Various Foods

The recommended daily value for adults is 1,000 mg.

Food	Serving Size	Milligrams (mg) Calcium
Tofu, calcium processed	⅓ cup	581
Yogurt, plain	8 oz container	411
Milk, skim and low-fat	1 cup	301
Sesame seeds, whole roasted	1 oz	297
Cheese, Swiss	1 oz	288
Cheese, cheddar	1 oz	216
Cheese, mozzarella	1 oz	194
Soybeans, cooked	½ cup	131
Turnip greens, cooked	½ cup	116
Black-eyed peas, cooked	½ cup	115
All-bran cereal	½ cup	106
Collard greens	½ cup	101
Sardines, canned	1 oz	105
Salmon, canned (with bones)	1 oz	59

Salt

Adults need about 3 grams of dietary salt per day (about a teaspoon) or they will become sick and possibly die. Salt is so important to life that you crave it when you don't have enough in your body.

When crystalline salt dissolves in water, it breaks into a unit of the chemical sodium and a unit of the chemical chloride. Salt is about 40% sodium. Every cell in the body needs sodium to function properly.

If salt is so important, then why do we hear that it is unhealthy to consume too much of it? The reason is that too much sodium can contribute to high blood pressure, a major risk factor for heart disease, stroke, and kidney failure.

The recommended upper limit of salt consumption per day for non-African American adults younger than 40 years of age is 5.8 grams (about 2,300 mg of sodium); for all African Americans and adults older than age 40, it's 3.8 grams (1,500 mg of sodium). The average U.S. adult consumes close to 8 grams of salt per day. It's estimated that reducing salt intake by an average of 3 grams per day would save several hundred thousand U.S. lives and more than \$10 billion in healthcare costs each year.

About 75% of the salt in the U.S. diet comes from manufactured, processed, and fast foods. A typical fast-food meal contains about 1,000 mg of sodium; some have twice that much. To enhance taste, salt is added to many packaged foods, including ketchup, mustard, salsa, and packaged and frozen meat, fish, and poultry. Health experts recommend a 50% reduction in the amount of sodium in processed, fast-food, and restaurant meals and improved food labeling to help consumers know the amount of sodium contained in food products and when a food is high in sodium. To reach international target goals of reducing salt in the diet by at least 25% by 2025, more than 75 countries have instituted salt-reduction strategies. These include engaging with industry to lessen salt added

to products, establishing targets for sodium content of foods, educating consumers about healthy salt consumption, mandating front-of-package sodium labeling, taxing high-salt foods, and providing healthy salt content in foods served in public institutions (Trieu et al., 2015). The United Kingdom instituted salt-reduction policies in 2003, which is credited with a considerable reduction within 10 years of average blood pressure and the number of deaths from heart disease and stroke (He, Pombo-Rodrigues, & MacGregor, 2014).

Phytochemicals

Many vegetables and fruits contain chemical substances referred to as **phytochemicals** that are not nutrients per se but that positively affect human physiology (**Table 5.11**). Phytochemicals may help the body destroy and eliminate toxins acquired from the environment or tissue-damaging by-products of metabolism such as oxygen free radicals. For example, cruciferous vegetables (e.g., broccoli, kale, cauliflower, brussels sprouts, cabbage, mustard greens) are rich in the cancer-preventing phytochemicals *sulforaphane* and *isothiocyanates*. Tomatoes and tomato products (ketchup, tomato sauce), pink grapefruit, papaya, peaches, and watermelon contain a phytochemical called *lycopene*, which protects against oxidative damage and reduces the risk of cancer and heart disease. *Lutein*, found in dark leafy and brightly colored vegetables, reduces the risk of heart disease and the eye disease of age-related macular degeneration. Green and black tea, onions, apples, and grapes contain a family of phytochemicals called *flavonoids* that also protect against cancer and heart disease. Dates, figs, and other dried fruits contain *polyphenols*, which are powerful antioxidants.

TABLE 5.11	Phytochemicals in Fruits and Vegetables and Their Possible Benefits
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Food	Phytochemicals	Possible Benefits
Blueberries, strawberries, raspberries, blackberries, currants, etc.	Anthocyanidins, ellagic acid	Antioxidants Cancer prevention
Chili peppers	Capsaicin	Possible antioxidant Topical pain relief
Citrus fruits Oranges, grapefruit, lemon, limes, etc.	Flavanones (tangeretin, nobiletin, hesperitin) Carotenoids	Antioxidants
Cruciferous vegetables	Indoles Isothiocyanates	Antioxidants Anticancer properties
Broccoli, kale, cauliflower, brussels sprouts, cabbage, mustard greens	Sulforaphane Carotenoids	Anticancer properties
Garlic family: garlic, onions, shallots, leeks, chives, scallions	Allylic sulfides Flavonoids (quercetin)	Anticancer properties
Soy	Daidzein, equol, genestein, enterolactone, and other plant estrogens	Reduce risk of breast, prostate cancer; reduce risk of heart disease

Water

Water is the principal constituent of blood and the major component of all cells. Water provides the medium in which all biological chemical activities take place.

Body water is maintained at a relatively constant level by the nervous, hormone, and urinary systems. If body water volume is low, a person experiences thirst, which motivates drinking. A low volume of body water activates hormonal mechanisms that reduce the production of urine. Excess body water volume activates certain hormonal mechanisms that increase the output of urine. Increasing urine output is the function of diuretics, drugs often given to reduce

blood pressure, fluid volume after a heart attack, or feelings of bloatedness. The popular maxim that you should drink eight glasses of water a day is partially correct. The average adult loses about that much body water through sweat, moisture in expired air, urine, and feces. This loss is partly offset by drinking water and obtaining water in other fluids and foods.

Body water should be replaced by consuming pure water, milk, tea, or real juice. So-called enhanced waters are not pure. They contain a few grams of sugar, a small amount of vitamins, and often caffeine. Soda also is a poor substitute for water because it may affect calcium metabolism and bone mass. Also, consuming soda replaces milk, giving the body less calcium with which to strengthen bones. Liquids containing caffeine (coffee, tea, sodas) and alcohol are diuretics, which means that some of the fluid ingested is lost in additional urine output.

Many people drink bottled water in the belief that it is more healthful than tap water. Not all bottled water comes from “natural” sources as the name of the product may suggest. The source of some bottled water products is a municipal water tap. One should look on the product label to ascertain the source of the water inside.



Rules for Organic Labeling

The U.S. Department of Agriculture sets standards for foods labeled “organic.” Foods labeled “100% organic” and “organic” cannot be produced using sewage sludge, ionizing radiation, artificial growth hormones, genetically modified crops, and most synthetic fertilizers and pesticides. The labeling requirements apply to both fresh products and processed foods. Foods that are sold, labeled, or represented as organic have to be produced and processed in accordance with the USDA standards, and they may carry the “USDA Organic” seal.

The labeling requirements are based on the percentage of organic ingredients in a product. Foods and food products labeled “100% organic” must contain only organically produced ingredients (excluding water and salt). Products labeled “organic” must consist of at least 95% organically produced ingredients. Any remaining ingredients must consist of nonagricultural substances approved on the national list of products that are not commercially available in organic form.

Processed products that contain at least 70% organic ingredients can use the phrase “Made with organic ingredients” and list up to three of the organic ingredients or food groups on the product label. For example, soup made with at least 70% organic ingredients and only organic vegetables may be labeled either “Soup made with organic peas, potatoes, and carrots” or “Soup made with organic vegetables.” Processed products that contain less than 70% organic ingredients cannot use the term *organic* anywhere on the principal display panel. However, they may identify the specific ingredients that are organically produced under ingredients on the information panel.

Data from USDA National Organic Program. (<https://www.ams.usda.gov/rules-regulations/organic/labeling>)

Food Additives

Almost all manufactured foods contain chemicals that are added during production to alter taste (sweeteners and salt), texture (thickeners), color (petroleum- or plant-derived dyes and colorings), stability (preservatives), and nutrient composition (nutraceuticals and functional foods) (Table 5.12). The U.S. Food and Drug Administration (FDA) Center for Food Safety and Applied Nutrition lists approximately 4,000 substances added directly to food (www.fda.gov/food/ingredientspackaginglabeling/foodadditivesingredients/ucm115326.htm).

TABLE 5.12	Some Types of Food Additives
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Type of Additive	Function	Common Sources	Common Label Names
Preservatives	Prevent or slow spoilage, changes in color, texture, flavor	Jellies, baked goods, cured meats, snacks, cereals, sauces	Ascorbic acid, citric acid, sodium benzoate, calcium propionate, sodium nitrite, calcium sorbate, BHA, BHT
Sweeteners	Add sweet taste	Many processed foods, candy, baked goods, beverages	Sucrose, high fructose corn syrup, corn syrup, aspartame, acesulfame, fructose
Colorings	Offset color loss because of light, air, temperature, moisture and storage; provide, correct and enhance natural color	Candies, snack foods, pie fillings, cheese, puddings, soft drinks, jams/jellies	FD&C Blue Nos. 1 and 2, FD&C Green No. 3, FD&C Red Nos. 3 and 40, FD&C Yellow Nos. 5 and 6, Orange B, Citrus Red No. 2, annatto extract, beta-carotene, grape skin extract, cochineal extract or carmine, paprika oleoresin, caramel color, fruit and vegetable juices, saffron
Flavorings	Spices, natural and artificial flavors	Ice cream, pudding, cake mixes, salad dressing, soft drinks, candy, BBQ sauce	Natural flavoring, artificial flavor, and spices
Flavor enhancers	Enhance flavors already present without providing a separate flavor	Many processed foods	Monosodium glutamate (MSG), salt, autolyzed yeast extract
Fat replacements	Provide expected texture and a creamy "mouth-feel"	Baked goods, dressings, frozen desserts, candy, cake mixes, dairy products	Cellulose gel, guar gum carrageenan, food starch, polydextrose, whey protein
Emulsifiers	Prevent separation, reduce stickiness, smooth mixing of ingredients	Salad dressings, peanut butter, chocolate, frozen desserts	Soy lecithin, mono- and diglycerides, egg yolks, sorbitan monostearate
Stabilizers, thickeners	Produce uniform texture, improve "mouth feel"	Frozen desserts, sauces, dairy products, cakes, jams, pudding, dressings	Gelatin, pectin, guar gum, carrageenan, xanthan gum, whey

Data from U.S. Food and Drug Administration (2017). Overview of Food Ingredients, Additives & Colors. www.fda.gov/Food/IngredientsPackagingLabeling/FoodAdditivesIngredients/ucm094211.htm#types

Description

Some additives promote health. For example, vitamins and minerals are added to highly processed white flour to replace nutrients lost in its production. Many so-called functional foods (see the Functional Foods section in this chapter) contain added substances that claim to enhance health, but often without supporting scientific evidence.

Many food additives are nutritionally unnecessary, and some may adversely affect health. For example, sugar and salt are added to many foods to intensify taste and thereby increase sales. Unfortunately, overconsumption of sugar and salt can have severe

health consequences. The U.S. Food and Drug Administration, the European Food Safety Authority, and many international agencies monitor the safety of chemicals added to food. Some chemical additives such as food colorings must be tested for safety by the manufacturer prior to being approved for use in foods. On the other hand, many kinds of food additives are not tested rigorously for safety before entering the food supply; safety issues arise only after an additive has been in use and a deleterious effect on consumers' health is suspected. At that point, the suspect chemical can undergo rigorous testing; if found to be harmful, food safety agencies can order that it be not approved for food products. Food safety regulations refer to untested additives that have been in use for a long time and that are not suspected of causing harm as *generally regarded as safe*. A suspected or potentially harmful chemical additive can be considered generally safe if it is present in foods in especially low amounts, which are referred to as *acceptable daily intake levels*.

Manufacturers are required to list all the additives in the order of their relative proportions on the ingredients label. Do not assume that the words *natural*, *organic*, or *health food* mean that foods are free from additives or extra sugar and salt. The only way to be certain of the contents of a food is to know how it was produced.

Preservatives

About 20% of the world's food supply is lost to spoilage each year. Common preservatives include butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and sodium nitrite. Each substance can be toxic and damaging to humans if consumed in excess; however, in amounts commonly present in food, they are presumed safe.

Sulfites in the form of sulfur dioxide, sodium sulfite, sodium or potassium bisulfite, and sodium or potassium metabisulfite are added to many foods to kill bacteria and to slow the food's chemical breakdown. Sulfites are commonly added to wine and to dehydrated soups, vegetables, and dried fruit (apples, apricots, raisins, pears,

and peaches). To keep vegetables looking fresh, they are also used in restaurant salad bars. Some individuals, particularly those with asthma, may be extremely sensitive to sulfites and may experience nausea, diarrhea, respiratory distress, and skin eruptions. Such problems have led to banning the use of sulfites in restaurants.

Dyes and Colorings

Dyes and colorings are added to foods to provide uniform color, enhance a food's visual appeal, and offset color loss because of exposure to light, air, temperature extremes, moisture, and storage conditions. Without color additives, colas wouldn't be brown and mint ice cream wouldn't be green.

The FDA is responsible for ensuring that foods containing dyes and colorings are safe to consume, contain only approved ingredients, and are accurately labeled. Some colorings are derived from petroleum and coal: FD&C Blue Nos. 1 and 2, FD&C Green No. 3, FD&C Red Nos. 3 and 40, FD&C Yellow Nos. 5 and 6, Orange B, Citrus Red No. 2. Others are derived from vegetables, minerals, or animals, such as caramel color, which is derived from sugar. Some petroleum-based dyes have been linked to hyperactivity and behavior problems in children (Center for Science in the Public Interest, 2016).

Artificial Sweeteners

Artificial sweeteners are chemicals capable of producing the sensation of sweetness far more effectively—from 200 to 10,000 times more, depending on the chemical—than sucrose, fructose, glucose, and other natural sugars. Six chemicals are approved for use as artificial sweeteners in North America: aspartame, saccharin, acesulfame-K, neotame, advantame, and sucralose. The chemical stevia is a low-calorie sweetener.



Guidelines for Food Safety

When Purchasing Food

1. Purchase meat and poultry products after all other groceries have been selected and keep packages of raw meat and poultry separate from other foods, particularly foods that will be eaten without further cooking. Consider using plastic bags to enclose individual packages of raw meat and poultry.
2. Make sure meat and poultry products—whether raw, prepackaged, or cooked from the deli—are refrigerated when purchased.
3. The USDA strongly advises against purchasing fresh, prestuffed whole birds.
4. Canned goods should be free of dents, cracks, or bulging lids.
5. Take food straight home to the refrigerator. If travel time will exceed one hour, pack perishable foods in a cooler with ice and keep groceries and cooler in the passenger area of the car during warm weather.

When Storing Food at Home

1. Verify the temperature of your refrigerator and freezer with an appliance thermometer—refrigerators should run at 40 °F (4 °C) or below; freezers at 0 °F (–18 °C). Most foodborne bacteria grow slowly at 40 °F, which is a safe refrigerator temperature. Freezer temperatures of 0 °F (–18 °C) or below stop bacterial growth (U.S. Food and Drug Administration, 2015).
2. At home, refrigerate or freeze meat and poultry immediately.
3. To prevent raw juices from dripping on other foods in the refrigerator, use plastic bags or place meat and poultry on a plate.
4. Wash hands with soap and water for 20 seconds before and after handling any raw meat, poultry, or seafood products.
5. Store canned goods in a cool, clean, dry place. Avoid extreme heat or cold, which can be harmful to canned goods.
6. Never store any foods directly under a sink and always keep foods off the floor and separate from cleaning supplies.

When Getting Food Ready to Prepare

1. The importance of handwashing cannot be overemphasized. This simple practice is the most economical yet often forgotten way to prevent contamination or cross-contamination.
2. Wash hands (gloved or not) with soap and water for 20 seconds: (a) before beginning preparation; (b) after handling raw meat, poultry, seafood, or eggs; (c) after touching animals; (d) after using the bathroom; (e) after changing diapers; and (f) after blowing your nose.

3. Don't let juices from raw meat, poultry, or seafood come in contact with cooked foods or foods that will be eaten raw, such as fruits or salad ingredients. Keep raw proteins below other items in the refrigerator to minimize the chance of contamination.
4. Wash hands, counters, equipment, utensils, and cutting boards with soap and water immediately after use. Counters, equipment, utensils, and cutting boards can be sanitized with a chlorine solution of 1 teaspoon liquid household bleach per quart of water. Let the solution stand on the board after washing, or follow the instructions on sanitizing products.
5. Thaw meat in the refrigerator, never on the counter. It is also safe to thaw in cold water in an airtight plastic wrapper or bag, changing the water every 30 minutes until meat is thawed; or thaw in the microwave and cook the product immediately.
6. Marinate foods in the refrigerator, never on the counter.
7. The USDA recommends that if you choose to stuff whole poultry, you must use a meat thermometer to check the internal temperature of the stuffing. The internal temperature in the center of the stuffing should reach 165 °F (74 °C) before removing it from the oven. If you don't have a meat thermometer, cook the stuffing outside the bird. Also, don't put hot stuffing into a frozen bird. By the time it thaws, it will be contaminated inside.

When Cooking

1. Always cook thoroughly. If harmful bacteria are present; only thorough cooking will destroy them. Freezing or rinsing the foods in cold water is not sufficient to destroy bacteria.
2. Use a meat thermometer to determine if your meat, poultry, or casserole has reached a safe internal temperature: 145 °F (63 °C) for roasts and steaks, 180 °F (82 °C) for whole poultry, 160 °F (71 °C) for ground meat, and 165° F (74 °C) for leftovers. Check the product in several spots to ensure that a safe temperature has been reached and that harmful bacteria such as *Salmonella* and certain strains of *Escherichia coli* have been destroyed.
3. Avoid interrupted cooking. Never refrigerate partially cooked food to later finish cooking on the grill or in the oven. Meat and poultry products must be cooked thoroughly the first time, and then they may be refrigerated and safely reheated.
4. When microwaving foods, carefully follow the manufacturer's instructions. Use microwave-safe containers, cover, rotate, and allow for the standing time, which contributes to thorough cooking.

When Serving

1. Wash hands with soap and water before serving or eating food.
2. Serve cooked products on clean plates with clean utensils and clean hands. Never put cooked foods on a dish that has held raw products unless the dish is first washed with soap and hot water.
3. Hold hot foods above 140 °F (60 °C) and cold foods below 40 °F (4 °C).
4. Never leave foods, raw or cooked, at room temperature longer than 2 hours. On a hot day with temperatures at 90 °F or warmer, this time decreases to 1 hour.

When Handling Leftovers

1. Wash hands before and after handling leftovers. Use clean utensils and surfaces.
2. Divide leftovers into small units and store in shallow containers for quick cooling. Refrigerate within 2 hours of cooking.
3. Discard anything left out too long.
4. Never taste a food to determine if it is safe.
5. When reheating leftovers, reheat thoroughly to a temperature of 165 °F (74 °C), or until hot and steamy. Bring soups, sauces, and gravies to a rolling boil.
6. If in doubt, throw it out.

Food Safety and Inspection Service, U.S. Department of Agriculture (2008). Kitchen Companion: Your Safe Food Handbook.



Tips for Eating Healthy When Eating Out

Full-service and fast-food restaurants, convenience stores, and grocery stores offer a variety of meal options. Typically, these meals are higher in calories, saturated fat, sodium, and added sugars than the food you prepare at home. Think about ways to make healthier choices when eating food away from home.

Consider Your Drink

Choose water, unsweetened tea, and other drinks without added sugars to complement your meal. If you drink alcohol, choose drinks lower in added sugars and be aware of the alcohol content of your beverage. Keep in mind that many coffee drinks may be high in saturated fat and added sugar.

Savor a Salad

Start your meal with a salad packed with vegetables to help you feel satisfied sooner. Ask for dressing on the side and use a small amount of it.

Share a Dish

Share a dish with a friend or family member. Or ask the server to pack up half of your entree before it comes to the table to control the amount you eat.

Customize Your Meal

Order a side dish or an appetizer-sized portion instead of a regular entree. They're usually served on smaller plates and in smaller amounts.

Pack Your Snack

Pack fruit, sliced vegetables, low-fat string cheese, or unsalted nuts to eat during road trips or long commutes. No need to stop for other food when these snacks are ready to eat.

Fill Your Plate with Vegetables and Fruit

Stir-fries, kabobs, or vegetarian menu items usually have more vegetables. Select fruits as a side dish or dessert.

Compare the Calories, Fat, and Sodium

Many menus now include nutrition information. Look for items that are lower in calories, saturated fat, and sodium. Check with your server if you don't see them on the menu. For more information, check www.FDA.gov.

Pass on the Buffet

Have an item from the menu and avoid the "all-you-can-eat" buffet. Steamed, grilled, or broiled dishes have fewer calories than foods that are fried in oil or cooked in butter.

Get Your Whole Grains

Request 100% whole-wheat breads, rolls, and pasta when choosing sandwiches, burgers, or main dishes.

Quit the "Clean Your Plate Club"

You don't have to eat everything on your plate. Take leftovers home and refrigerate within 2 hours. Leftovers in the refrigerator are safe to eat for about 3 to 4 days.

U.S. Department of Agriculture. Tips for Eating Healthy When Eating Out. Retrieved from <http://www.choosemyplate.gov/healthy-eating-tips/tips-for-eating-out.html>

Although touted as aids to weight control, diabetes management, and moderating tooth decay, artificial sweeteners have yet to be shown to promote health in any way. Thinking that artificial sweeteners are healthy, people may choose artificially sweetened junk foods in place of natural foods. Some may think that because they consume artificial sweeteners they can have more pastries or other sweets or fatty foods such as french fries. Furthermore, artificial sweeteners may alter physiological mechanisms that lead to increases in abdominal fat deposition and weight, overweight, and obesity and the risk of high blood pressure, metabolic syndrome, diabetes, depression, kidney dysfunction, heart attack, stroke, and

even cardiovascular and total mortality. Much remains to be studied about the safety of artificial sweeteners (Fowler, 2016).

Functional Foods

When vitamins, minerals, herbs, or other substances are added to foods to allow the manufacturer to make health claims, the food is called a **functional food**. Americans have been eating functional foods since 1924, when iodine was added to salt to prevent goiter, a disease of the thyroid gland caused by iodine deficiency. For many years after that, some foods (such as enriched flour) were fortified with extra vitamins and minerals but without the manufacturer making health claims. That changed in 1993 when the FDA ruled that milk and yogurt, which contain high amounts of calcium, could carry labels claiming that the products helped prevent osteoporosis. Nondairy food manufacturers quickly began adding calcium to their products—orange juice, waffles, potato chips—so they, too, could make health claims.

Since then, food manufacturers have found that adding substances to foods in order to make health claims is good business, even if the added substances have not been shown scientifically to be helpful. Thus, we now have sodas with ginseng (for relaxation), cereals with psyllium husk (to protect against heart disease or cancer), margarine with plant-derived sterols (to lower cholesterol), ice cream with echinacea (to help the immune system), and soups with St. John's wort (to combat depression).

Neither the health claims nor the purity and amount of additives in functional foods are tested or regulated by the FDA. Herbs added to foods may be dangerous because amounts are not well controlled; in some instances (e.g., St. John's wort), the herb can interfere with the action of certain medications. Some people may mistakenly believe that more is better and risk overdose with a vitamin, mineral, or plant product by ingesting both dietary supplements and a functional food. Moreover, functional foods often cost more—sometimes a lot more—than equivalent foods without added chemicals do.

Food Safety

Every year, hundreds of outbreaks of food poisoning in the United States from bacterial and viral contamination of commercial beef, poultry, fruit, and vegetables have raised concerns about the safety of the food supply. In the United States, there are 48 million cases of foodborne illness annually, resulting in 128,000 hospitalizations and 3,000 deaths. Six pathogens—*Salmonella*, *Clostridium perfringens*, *Campylobacter*, norovirus, *Staphylococcus aureus*, and *Toxoplasma*—account for most of the infections and approximately 1,600 deaths each year (**Table 5.13**). Symptoms of bacterial food poisoning are headache, nausea, fever, abdominal cramps, and diarrhea.

TABLE 5.13 Pathogens That Cause Foodborne Illness

Pathogen	Found	Transmission	Symptoms
<i>Campylobacter jejuni</i>	Intestinal tracts of animals and birds, raw milk, untreated water, and sewage sludge.	Contaminated water, raw milk, and raw or undercooked meat, poultry, or shellfish.	Fever, headache, and muscle pain followed by diarrhea (sometimes bloody), abdominal pain, and nausea. Symptoms appear 2 to 5 days after eating; may last 7 to 10 days.
<i>Clostridium botulinum</i>	Widely distributed in nature; in soil, water, on plants, and in intestinal tracts of animals and fish. Grows only in little or no oxygen.	Bacteria produce a toxin that causes illness. Improperly canned foods, garlic in oil, vacuum-packed and tightly wrapped food.	Toxin affects the nervous system. Symptoms usually appear 18 to 36 hours after eating but can sometimes appear as few as 4 hours or as many as 8 days after eating; double vision, droopy eyelids, trouble speaking and swallowing, and difficulty breathing. Fatal in 3 to 10 days if not treated.
<i>Clostridium perfringens</i>	Soil, dust, sewage, and intestinal tracts of animals and humans. Grows only in little or no oxygen.	Called “the cafeteria germ” because many outbreaks result from food left for long periods in steam tables or at room temperature. Bacteria destroyed by cooking, but some toxin-producing spores may survive.	Diarrhea and gas pains may appear 8 to 24 hours after eating; usually last about 1 day, but less severe symptoms may persist for 1 to 2 weeks.
<i>Escherichia coli</i> O157:H7	Intestinal tracts of some mammals, raw milk, unchlorinated water; one of several strains of <i>E. coli</i> that can cause human	Contaminated water, raw milk, raw or rare ground beef, unpasteurized apple juice or cider, uncooked fruits and vegetables; person to person.	Diarrhea or bloody diarrhea, abdominal cramps, nausea, and malaise; can begin 2 to 5 days after food is eaten, lasting about 8 days. Some, especially the very young, have developed hemolytic-uremic syndrome (HUS), which causes

	illness.		acute kidney failure. A similar illness, thrombotic thrombocytopenic purpura (TTP), may occur in adults.
<i>Listeria monocytogenes</i>	Intestinal tracts of humans and animals, milk, soil, leafy vegetables; can grow slowly at refrigerator temperatures.	Ready-to-eat foods such as hot dogs, luncheon meats, cold cuts, fermented or dry sausage, and other deli-style meat and poultry, soft cheeses, and unpasteurized milk.	Fever, chills, headache, backache, sometimes upset stomach, abdominal pain and diarrhea; may take up to 3 weeks to become ill; may later develop more serious illness in at-risk patients (pregnant women and newborns, older adults, and people with weakened immune systems).
Norovirus	Human intestinal tract.	Person to person.	Nausea, vomiting, diarrhea, resolving in 1 to 2 days.
<i>Salmonella</i> (more than 2,300 types)	Intestinal tracts and feces of animals; <i>Salmonella enteritidis</i> in eggs.	Raw or undercooked eggs, poultry, and meat; raw milk and dairy products; seafood; and food handlers.	Stomach pain, diarrhea, nausea, chills, fever, and headache usually appear 8 to 72 hours after eating; may last 1 to 2 days.
<i>Shigella</i> (more than 30 types)	Human intestinal tract; rarely found in other animals.	Person to person by fecal–oral route; fecal contamination of food and water. Most outbreaks result from food, especially salads, prepared and handled by workers using poor personal hygiene.	Disease referred to as shigellosis or bacillary dysentery. Diarrhea containing blood and mucus, fever, abdominal cramps, chills, and vomiting; 12 to 50 hours from ingestion of bacteria; can last a few days to 2 weeks.
<i>Staphylococcus aureus</i>	On humans (skin, infected cuts, pimples, noses, and throats).	Person to person from improper food handling. Multiply rapidly at room temperature to produce a toxin that causes illness.	Severe nausea, abdominal cramps, vomiting, and diarrhea occur 1 to 6 hours after eating; recovery within 2 to 3 days—longer if severe dehydration occurs.

Data from U.S. Department of Agriculture (2021). Foodborne Illness and Disease. _x000B_ <https://www.fsis.usda.gov/food-safety/foodborne-illness-and-disease>.

Description Description

The foods most likely to be contaminated with infectious microorganisms are raw meat and poultry, raw eggs, unpasteurized milk, and raw shellfish. Foods that mingle the products of many individual animals such as bulk raw milk, pooled raw eggs, or ground beef are particularly hazardous because a pathogen present in an individual animal can contaminate the entire mix. For example, a single hamburger may contain meat from hundreds of animals. A single restaurant omelet may contain eggs from hundreds of chickens. A glass of raw milk may contain milk from hundreds of cows.

Besides animal products, uncooked fruits and vegetables also carry pathogenic microorganisms from improper handling and processing—for example, using contaminated water to wash fresh produce after it is harvested. Another source of contamination is

fresh manure used to fertilize food crops. Unpasteurized fruit juice can also be contaminated if there are pathogens in or on the fruit that is used to make it.

In 2011, Congress passed the Food Safety Modernization Act, which gave the FDA authority to put greater emphasis on preventing rather than responding to outbreaks of foodborne illness. The law requires food companies to develop and implement food safety plans and permits the FDA to require recalls when food safety problems occur and to develop systems to ensure that imported foods are as safe for consumers as foods produced in the United States. It also is recognized that the FDA and U.S. Department of Agriculture do not have the staff to oversee nearly 60,000 food manufacturers and processors and billions of tons of imported food. That's why it's imperative for consumers to follow food safety guidelines when they purchase, store, and prepare food (see the Wellness Guide: Guidelines for Food Safety).

One method of protecting food involves exposing it to **gamma irradiation** to destroy fungi, bacteria, and other microorganisms. The U.S. government allows irradiation for sterilizing insects, extending shelf life, controlling pathogens and parasites, and inhibiting the sprouting of vegetables. Irradiation also is approved for red meat, poultry, pork, fruits and vegetables, some spices, seeds, herbs and seasonings, eggs, and wheat. At approved doses, irradiation does not eliminate toxins, prions (agents that cause mad cow disease), and many types of viruses. Irradiation does not prevent subsequent contamination of food by food service workers or consumers, a major source of bacterial and viral contamination.



Hand washing is essential to safe food preparation.

© Lacheev/iStock /Getty Images Plus/Getty Images

Keep in mind that irradiation *does not* make food radioactive and therefore consumers are not at risk from radiation. The U.S. government requires a written radiation disclosure statement on the label of irradiated foods; the use of the radura symbol (**Figure 5.10**), however, is optional.



Figure 5.10 The Radura Symbol. The radura symbol is used internationally to indicate that a food has been treated with irradiation.

Description

Some opponents of food irradiation argue that the method has not been proven safe in all instances. Their concern is that irradiation may produce cancer-causing or toxic by-products or mutant strains of toxic, radiation-resistant microorganisms. Furthermore, vitamins can be destroyed by irradiation.

Genetically Modified Foods

Genetically modified foods, referred to as *genetically modified organisms* (GMOs), are agricultural plants and animals in which one or more genes have been altered using modern biotechnological methods. Other words for genetically modified are *genetic engineering* and *transgenic*.

Prior to the invention of GMOs in the 1990s, most plants and animals in the North American food supply were created by breeders who mated individuals with particular traits to produce offspring with those traits. For example, suppose you want a big, good-tasting tomato. You start by finding a tomato plant in Nature that produces good-tasting tomatoes. Then you find a different tomato plant that produces large tomatoes. You crossbreed the two plants, and plant the offspring seeds. After many tries (and possibly many growing seasons), you have the large, good-tasting tomatoes you originally wanted.

Compared to conventional plant and animal breeding, which requires combining genes from organisms of the same species, genetically modified organisms can be engineered with genes from *different* species. For example, genes from a daffodil and a particular bacterium have been inserted into a type of rice so it contains vitamin A, which in Nature it does not. This was done to help prevent childhood blindness in the developing world.

The major genetically modified crops grown commercially are herbicide- and insecticide-resistant soybeans, corn, cotton, and canola. Other crops grown commercially or field-tested are sweet potato resistant to a virus that could destroy most of the African harvest, rice with increased iron and vitamins that may alleviate chronic malnutrition in Asian countries, and a variety of plants that are able to survive weather extremes. There are bananas that produce human vaccines against infectious diseases such as hepatitis B, fish that mature more quickly, fruit and nut trees that

yield fruit years earlier than usual, plants that produce new plastics with unique properties, and yeast that produce fuel oil.

Technologies for genetically modifying foods offer dramatic promise for meeting some of the greatest challenges for the future. Like all new technologies, they also pose some risks, both known and unknown. With concern about possible health and environmental effects of consuming genetically modified plants and the food products derived from them. Canada, many countries in the European Union, and Japan have banned all GMOs in foods. On the other hand, China, India, Brazil, and many other countries have embraced GMOs and see them as a solution to food shortages and agricultural inefficiency. Some of the problems and concerns about GMOs include the following.

- Planting crops that are resistant to herbicides poses a major threat to the environment and possibly to people. To control weeds, every year growers spray hundreds of millions of pounds of herbicide onto crops. Often other toxic chemicals are added to Roundup (glyphosate) to make it more effective and long lasting. This promotes contamination of soil and water. Roundup contaminates farm workers and others regularly exposed to the herbicide.
- Inserting nonnative genes into plants and animals may increase the risk that the genetically modified organism causes allergic reactions, a valid but as yet unobserved danger. People have been eating genetically modified corn and soy for more than a decade. In the United States, no adverse health effects on the American population have been observed.
- Pollen from GMOs can be blown by wind onto nearby fields and can contaminate other crops. Farmers trying to grow organic corn have had their corn contaminated by pollen from nearby

genetically modified corn. Small organic farms may find it difficult to avoid contamination of their crops.

- Genetic engineering is regarded as “evil,” “dangerous,” and “sinful” by some opponents of GMOs. These critics often refer to foods produced from genetically engineered plants as “Frankenfoods.”

One way to lessen any health and environmental risks of GMOs is to test them thoroughly before they are used. Because testing and regulation can reduce some but not all risks of buying foods labeled *organic* helps avoid GMO products. A majority of the U.S. population wants GMO foods to be labeled as such. Fearing that labeling products as genetically modified would drive away many consumers and arguing that most Americans have been consuming genetically modified foods for many years without and yet identified ill effects, agribusiness companies resist GMO labeling.

Fast Food

Student: You're always telling us not to eat fast food. If it's so bad, why is it so cheap, easy to get, and taste so good?

Health Instructor: Just because fast food is everywhere, convenient, inexpensive, and concocted by chemists to appeal to the human taste system doesn't mean it's healthy.

Despite the fact that about 75% of American adults say that fast food is “not too good for you” or “not good at all for you” (Gallup Poll, 2013), approximately 50% of American adults consume fast food at least one time each week; about 4% consume fast food daily. The reasons for patronizing such establishments are low cost, convenience (they are everywhere—more than 200,000 worldwide), a perceived lack of time to shop and prepare meals at home, fast food's taste and texture, and the need to feed children quickly. One-third of American children and adolescents consume fast food every day (Vikraman, Fryar, & Ogden, 2015).

Compared to nonregular fast-food consumers, those who regularly consume fast food ingest between 150 and 200 more calories per day, which can contribute to a gain of several pounds in a year. Moreover, the large amounts of salt, fat, and sugar in fast food set these consumers on a course for high blood pressure, type 2 diabetes, heart disease, and blocked arteries (Bahadoran, Mirmiran, & Azizi, 2015).

Convenience notwithstanding, fast-food items must be chosen carefully because many contain high quantities of saturated fat, cholesterol, and salt; few complex carbohydrates; and low levels of vitamins A and C (**Table 5.14**). The major fast-food companies have responded to consumers' concerns about nutrition by offering salads, baked potatoes, roast beef, and broiled chicken. Roast beef has less fat than hamburger, and broiled chicken breast has less fat than deep-fried chicken. Be cautious, though. Supposedly a low-fat food, fish—if breaded and fried—may be 50% fat. Salads and baked potatoes can be carriers of high-fat toppings.

TABLE 5.14 | **Approximate Composition of Selected Fast-Food Items**

Food	Total Calories	Total Fat (Grams)	Calories from Fat	Cholesterol (Milligrams)	Sodium (Milligrams)
Adult-sized hamburger (beef)	600	29	260	75	1,040
Adult-size burrito (beef)	410	16	140	30	1,140
French fries (medium, salted)	450	22	200	0	290
Turkey sub sandwich	280	4	30	20	730
Fried chicken breast	360	21	190	110	1,080
Cheese pizza (6" personal)	590	25	220	50	1,350
Caesar salad (no dressing)	90	5	45	10	180
Caesar salad (with dressing)	390	21	190	50	820
Chocolate shake	690	18	160	40	380
Blended coffee drink with whipped cream	420	9	180	55	270

Data from Fast Food Nutrition (2021). Retrieved from <http://www.fastfoodnutrition.org/>

Description

Vegetarian Diets

Vegetarianism has existed as long as humankind has and has been advocated by such famous people as Leonardo da Vinci, Benjamin Franklin, George Bernard Shaw, Mahatma Gandhi, Albert Einstein, Steve Jobs, Paul McCartney, and Ellen DeGeneres. People choose to be vegetarians for various reasons, including:

1. To avoid killing animals—either killing them oneself or killing by others. Some people who have a strong affection for other animals and feel a certain biological and spiritual kinship with them object to killing them for food.
2. To contribute to the more efficient utilization of world protein supplies. It takes approximately 10 pounds of livestock feed, usually corn or soybeans, to produce 1 pound of meat. Obviously, the 10 pounds of corn or soybeans could feed more people than 1 pound of meat can. With the population of Earth doubling approximately every 30 years, some people feel a moral obligation to avoid overconsuming food resources in the hope that ways will be found to distribute the world food supply more equitably.
3. To live longer and healthier lives. A study of more than 34,000 Seventh-day Adventists in California, most of whom were vegetarians, showed that vegetarian dietary patterns were associated with less overweight and obesity, lower prevalence and incidence of diabetes, lower prevalence of high blood pressure, lower all-cause mortality, and in some instances, lower risk of cancer. Other studies have shown that vegetarian Adventists take fewer medications and experience fewer medical procedures. The explanation: Compared to a nonvegetarian diet, a vegetarian diet prevents heart disease and cancer because it has less saturated fat and cholesterol, and more fiber, antioxidant vitamins, and plant-derived chemicals that are good for health (Orlich & Fraser, 2014).

4. To encourage food and environmental sustainability. A plant-based diet reduces the demand for raised livestock, which is a major stress on ecosystems and on the planet as whole.



Self-Care Exercise: Fast-Food Research

Because fast food is so popular and prevalent, it is healthful to know the nutrient content of the fast food you consume. Even if you do not patronize such establishments yourself, you can share these observations with a friend.

- Choose a fast-food meal that is typical for you and list the meal's components (e.g., burger, fries, and milk shake).
- For each of your meal's components, determine the total calories, grams of protein, total grams of fat, total grams of saturated fat, milligrams of cholesterol, milligrams of salt, and grams of fiber. You can get this information from the establishment's website, in-store brochure, or the following website: <http://fastfoodnutrition.org>.
- Calculate the dollar cost of the energy content of the meal by dividing the total calories by the total cost. This tells you how much bang (i.e., energy) you are getting for your buck.
- Calculate the percentage of your estimated daily calories contributed by this meal (divide the calories in your meal by your daily calorie need). (Refer to the Health Tips box, "Estimating Your Daily Calorie Needs" on page XXX.)

There are several kinds of **vegetarian** diets:

- strict or *veganism*, which excludes all animal products, including milk, cheeses, eggs, and other dairy products;
- *lacto-vegetarianism*, which excludes meat, poultry, fish, and eggs but includes dairy products;
- *lacto-ovo-vegetarianism*, which excludes meats, poultry, and seafood but includes eggs and dairy products; and
- *ovo-vegetarianism*, which excludes meat, poultry, sea food, and dairy but includes eggs.

Properly planned vegetarian diets can meet the body's nutritional needs, especially by combining sources of protein to ensure adequate intake of the essential amino acids. Vegans may need vitamin B₁₂ (cobalamin) supplements.

How Food Affects the Brain

The brain requires nutrients to function properly. For example, adequate protein in the diet provides nutrients for the manufacture of the neurotransmitters acetylcholine (choline), dopamine, epinephrine, and norepinephrine (from tyrosine), gamma-aminobutyric acid (from glutamine), histamine (from histidine), and serotonin (from tryptophan).

Don't buy much from the center aisles of the supermarket. Avoid packaged food with more than five ingredients and anything with a cartoon on it.

—Marian Nestle What to Eat

To some degree, moods, feelings of vitality, and sleep patterns may depend on the amount of neurotransmitter molecules ingested and therefore depend indirectly on meals (Hogenelst, Schoevers, & Rot, 2015). Tyrosine may help to relieve depression and choline may help to modify certain postural and motor disturbances.

Also, some individuals can experience a strong, uncontrollable preference (craving and compulsive consumption) for certain foods or certain kinds of foods, particularly foods high in fat, sugar, and salt. When craving, these individuals show patterns of brain activity similar to those observed in drug addiction (Carter et al., 2016). Apparently, prior exposure to the craved foods activates the brain's reward centers and conditions the susceptible person to certain patterns of eating behaviors.

The thoughts, moods, and body sensations of some individuals are sensitive to the amount of fat and sugar they ingest. We all know of individuals who use certain foods—chocolate, fatty, and sugary foods (so-called comfort foods)—to lessen the experience of stress

or emotional upset or for consolation when feeling sad, lonely, or fatigued. Some individuals experience anxiety, fatigue, weakness, depressed mood, and an inability to concentrate shortly after consuming a couple of doughnuts or a candy bar. This response, called **reactive hypoglycemia**, is often the result of a sharp rise in the hormone insulin in reaction to the large load of sugar. The jolt of insulin causes a sharp drop in blood sugar, resulting in feelings of fatigue. Something akin to reactive hypoglycemia may be at the root of an eating pattern common to many: consumption of a high-sugar food at breakfast, followed 2 hours later by a reactive blood sugar low, which motivates a going for a midmorning sugar “hit.” The cycle is repeated at noon and midafternoon and then at dinner and late in the evening. To break this cycle, it helps to consume complex carbohydrates with protein and some fat, thereby moderating the rate at which simple sugars enter the body.

Because the human brain develops extensively during the late fetal period and the first three postnatal years, optimal brain development is dependent on key nutrients derived from the mother such as glucose and oxygen for cellular energy production, protein for the manufacture of cellular material, amino acids for neurotransmitters, several vitamins, and the minerals iron, zinc, iodine, and copper. Nutrient deficiencies in early development can result in a variety of difficulties in late childhood and adulthood. Among these are impaired memory and cognition, slower neural processing, increased wariness, movement abnormalities, and susceptibility to depression (Georgieff, Ramel, & Cusick, 2018). Maternal starvation during pregnancy is associated with an increased risk in children of schizophrenia, antisocial personality, and affective disorders (McGrath, Brown, & St. Clair, 2011).

By contrast, adequate fetal nutrition can have lifelong beneficial effects. Fetal intake of polyunsaturated fatty acids has beneficial effects on memory function by the time a child reaches school age (Boucher et al., 2011).

Critical Thinking About Health

1. Everyone aboard the Zoracian space vehicle XTA-9781 was thrilled when their ship's sensors indicated life forms on a small planet orbiting a medium-sized star in the Milky Way galaxy. To make contact with and explore the planet, a landing party of six underwent molecular rearrangement to take on human form both to survive on Earth and communicate and interact with any Earthlings they encountered.

"When you reach the surface," explained the mission commander, "you will have about eight of their time segments before you must refuel. Energy packets can be obtained in large, stationary pods the locals call supermarkets."

The crew of the landing party nodded. It seemed similar enough to refueling on their home planet of Zorax not to cause confusion.

"Except for one thing," the commander cautioned. "There are thousands of kinds of energy packets, from which you will have to choose the appropriate ones."

"Appropriate ones?" asked the assistant crew-chief.

"Yes. None of the fuel packets are efficient. You will have to sort and select."

The crew shifted nervously.

"Do not worry," said the commander, handing each member of the crew a copy of the U.S. Department of Agriculture's *Dietary Guidelines for Americans 2020–2025*. "Their leaders have prepared refueling guidelines. Take these and use them when the time comes."

- a. How would you explain to the Zoracian landing party why, with the great abundance of food choices in American supermarkets, the U.S. government advises its citizens how to eat properly?
- b. From the Zoracians' point of view, the American food supply, although abundant with many kinds of foods, is inefficient with

regard to refueling. Explain why the American food supply is so diverse yet nutritionally inefficient.

- c. What factors influence your food selection?
2. A crusading nutrition journalist points out that the food label on a soup company's best-selling product indicates that the product has 6 grams of fat. Fearing that consumers will stop buying the product, the company responds, and within weeks the label indicates that the product has 3 grams of fat. The company has changed nothing in the product.
 - a. Why does the label show that the product contains half the fat?
 - b. What limits, if any, would you advocate be placed on what food manufacturers can put on product labels? Where would you draw the line between free enterprise, *caveat emptor* (buyer beware), and the public good?
 - c. How much attention do you pay to what is written on food product labels?
3. Explain how an herbicide (weed-killing chemical) could wind up in the breast milk of a woman living hundreds of miles away from the site of herbicide application. Are you concerned about pesticides and additives in the food supply? Why or why not?

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Nearly everyone loves to eat—some more than others. Obtaining and consuming food is a basic need of all living organisms, including human beings. At one time, people hunted for and gathered food from the wild; now food is supplied by a gigantic food industry that would like you to buy and consume everything it manufactures regardless of its nutritional value or contribution to health. Government agencies try to help you eat properly by issuing nutritional guidelines and by requiring food manufacturers to list ingredients and nutritional values on all food products and packages. But judging from the epidemic of overweight and obesity in the United States and other countries, overconsumption of food, especially food of low nutritional value, has become the norm. To be healthy, you need to become a smart and careful food shopper, both in supermarkets and in restaurants. Many diets and food choices can be healthy. You can decide to be a strict vegetarian or you can decide to add fish to a vegetarian diet. You can eat some kinds of meat but not others. The important thing is to eat a balanced diet, which means that you are getting all the essential ingredients that your body needs—proteins, carbohydrates, fats, water, vitamins, essential minerals, and phytochemicals. A balanced diet, regardless of food sources, provides all the chemical ingredients your body needs to grow and function.

Eating healthfully does not mean you must never have a soda, a doughnut, a hamburger, a hot dog, or some kind of “junk” food. Everyone can overeat sometime; most of us overeat on holidays. Health is achieved by eating a modest amount of quality, fresh foods most of the time. Do not feed with food negative emotions, boredom, or unhappiness. Avoid foods grown with lots of chemicals and pesticides. As much as possible, buy fresh organic fruits, vegetables, and meats. Paying more for quality may also help you eat less.

When shopping for food in a supermarket, follow this rule: Shop mostly from the edges of the market, and buy as little as possible from the inside shelves. Produce, dairy, meats, and fresh breads are almost always arranged along the walls of the market. Inside aisles and shelves contain processed foods. Buy as little of the packaged, canned, bottled, and frozen foods as possible. Your body and brain will thank you.

HIGHLIGHTS

- The U.S. government and a variety of health organizations have created dietary guidelines to help people make nutritional choices to prevent heart disease, cancer, and other diseases based on the consumption of whole grains, fruits, and vegetables while limiting the consumption of meats, whole-fat dairy products, salt, and fatty, sugary snacks and sweets.
- MyPlate emphasizes the consumption of polyunsaturated fats, fruits, and vegetables rather than refined-grain products, meats, and sweets.
- The ingredients label on a food product lists the components of the product in descending order by weight.
- The Nutrition Facts label provides information on the amounts of certain nutrients in a food product.
- Food has three functions: to provide chemical constituents of the body, energy, and pleasure.
- Food is composed of seven components: protein, carbohydrate, fat, water, vitamins, minerals, and phytochemicals.
- **Dietary supplements** are unregulated substances that are used to augment the nutritional adequacy of the diet and as

drugs to heal or prevent illness.

- Manufactured foods contain a variety of additives that alter their texture, flavor, color, and stability. Preservatives keep foods from spoiling through the use of sulfites.
- One nonchemical method of food preservation involves exposing food to gamma irradiation to destroy microorganisms.
- Artificial sweeteners are widely used, most commonly in diet soft drinks.
- There are several reasons for being a vegetarian, including increased interest in health, ecology, and world issues; economic issues; and the philosophy of not killing animals. A strict vegetarian, or vegan, diet eliminates all animal products, including milk, cheese, eggs, and other dairy products.

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KEY TERMS

nutrient dense:

food items that are high in nutrition in proportion to their calorie content

calorie dense:

food items that contain considerable calories but are of little nutritional value

processed foods:

industrial products derived from natural foods to which salt, sugar, oils and fats, and other chemicals are added to modify taste and consistency

cholesterol:

a fatlike compound occurring in bile, blood, brain, nerve tissue, liver, and other parts of the body

MyPlate:

a graphic to remind people of the composition of a healthy diet

ingredients label:

label on a manufactured food that lists the ingredients in descending order by weight

Nutrition Facts label:

label on a manufactured food that lists the quantity of certain nutrients in the food and the percent daily value for those nutrients

percent daily value (PDV):

percentage of the recommended daily amount of a particular nutrient found in a food

date label:

a manufacturer's or a store's assessment of when a food product is at peak quality; not related to when the product poses a potential health risk

essential nutrients:

chemical substances obtained from food and needed by the body for growth, maintenance, or repair of tissues; not made by the body; must be obtained from food

Dietary Reference Intakes (DRIs):

recommended nutrient intakes intended to prevent chronic diseases

calorie:

the amount of energy required to raise 1 g of water from 14.5°C to 15.5°C

nutritional calorie:

unit of energy; often used interchangeably with the term kilocalorie

kilocalorie:

unit of energy; the amount of heat needed to raise 1 kilogram of water 1°C, equivalent to 1,000 calories

metabolism:

the process of obtaining energy and matter from the chemical breakdown of molecules obtained from food or from the body

basal metabolism:

the minimum amount of energy needed to keep the body alive

basal metabolic rate (BMR):

the amount of energy needed to keep the body functioning while at rest

proteins:

complex biological chemicals, each with an important role in the structure, function, and regulation of the body's tissues and organs

amino acids:

compounds containing nitrogen that are the building blocks of protein

essential amino acids:

amino acids that cannot be synthesized by the body and must be provided by food

protein complementarity:

combining sources of dietary protein such that amino acid deficiencies in one are counterbalanced by abundances in another

carbohydrates:

biological substances composed of one or more sugar molecules

simple sugars:

a class of carbohydrates called monosaccharides; all carbohydrates must be reduced to simple sugars to be digested

glucose:

the principal source of energy in all cells; also called dextrose

fructose:

a simple sugar found in fruits and honey

sucrose:

common refined table sugar; a molecule of glucose and a molecule of fructose chemically bonded together

lactose:

a sugar formed by glucose and galactose chemically bonded together; found primarily in milk

lactase:

enzyme secreted by glands in the small intestine that converts lactose (milk sugar) into simple sugars

complex carbohydrates:

a class of carbohydrates called polysaccharides; foods composed of starch and cellulose

starch:

complex chain of glucose molecules

gluten:

a mixture of proteins that occur naturally in wheat, rye, barley and crossbreeds of these grains, which can damage the small intestine

glycogen:

the form in which carbohydrate is stored in humans and animals

fiber:

a group of compounds that make up the framework of plants; fiber cannot be digested

insoluble fiber:

cannot be dissolved in water

soluble fiber:

can be dissolved in water

cellulose:

a carbohydrate forming the skeleton of most plant structures and plant cells; the most abundant polysaccharide in nature and the source of dietary fiber

hemicellulose:

substances found in plant cell walls that are composed of various sugars chemically linked together

lipids:

fats such as cholesterol and triglycerides

lecithin:

an essential component of cell membranes

linoleic acid:

an essential fat that must be obtained from food

triglyceride:

a storage form of fat

fatty acids:

naturally occurring in fats, either saturated or unsaturated (monounsaturated or polyunsaturated)

monounsaturated fatty acid (MUFA):

carries one less than all the hydrogen atoms it possibly could

polyunsaturated fatty acid:

carries at least two fewer hydrogen atoms than it would if saturated

saturated fat:

generally solid at room temperature; comes from animal sources

trans fatty acid:

also trans fat, an artificial fat manufactured by chemically modifying monounsaturated and polyunsaturated fatty acids

fat substitutes:

chemicals added to packaged foods to provide the taste and texture of fat but few or no calories

vitamins:

essential organic substances needed daily in small amounts to perform specific functions in the body

water-soluble vitamins:

soluble in water; there are nine water-soluble vitamins

fat-soluble vitamins:

soluble in fat; there are four fat-soluble vitamins

antioxidants:

vitamins that have the capacity to neutralize the effects of chemicals called *free radicals*, which can damage biological structures via chemical oxidation

minerals:

materials such as sodium, potassium, and chlorine that are essential for maintaining cell membranes, conducting nerve impulses, and contracting muscles

phytochemicals:

non-nutrient health-promoting chemicals produced by plants

sulfites:

used as preservatives for salad, fresh fruits and vegetables, wine, beer, and dried fruit; in susceptible individuals, especially those with asthma, they can cause a severe reaction

functional food:

a food to which additional vitamins, minerals, herbs, or other substances are added to allow the manufacturer to make health claims

gamma irradiation:

nonchemical method of food preservation

genetically modified food:

agricultural plants and animals into which one or more genes from other organisms have been inserted (also called *genetically modified organisms*, or GMOs)

vegetarian:

one who consumes no meat, poultry, or fish

reactive hypoglycemia:

occurring after the ingestion of carbohydrate, with consequent release of insulin

dietary supplements:

products that provide one or more of the 40 essential nutrients or nonessential vitamins, minerals, enzymes, amino acids, herbs, hormones, and nucleic acids



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CHAPTER 6

Managing a Healthy Weight



Health Tips

Walk the Walk

Mindful Eating

Inform Yourself: Don't Buy Worthless and Sometimes Harmful Weight-Loss Products



Global Wellness

Eating Disorders Are a Worldwide Concern



Managing Stress

Treating the Underlying Emotional Causes of Obesity



Wellness Guide

Self-Care: Fast-Food Research

Uncle Joe's Successful Weight Loss

LEARNING OBJECTIVES

1. Describe the extent and causes of overweight in American society.
2. Describe the significance of body mass index (BMI) to health.
3. Describe the body's energy-control system and factors affecting it.
4. Explain why calorie-restriction weight-loss regimens fail.
5. List the features of sensible weight management.
6. Discuss the advantages and disadvantages of medical treatments for overweight.
7. Describe common weight-loss fads and fallacies.
8. Define *anorexia nervosa*, *bulimia*, and *binge eating disorder*.

Overweight has become a health problem in the United States and the world. The body weights of about 73% of the American adult population (both women and men) are higher than medically recommended. The body weights of nearly half of the American adult population put them at risk for serious disease and early death (Hales, Carroll, Fryar, & Ogden, 2020). About 38% of Canadians weigh more than medically recommended, and 27% are overweight to the point of being at risk for disease and early death (Statistics Canada, 2019). One-third of U.S. children between ages 6 and 19 are also overweight. An estimated 1.9 billion adults worldwide are overweight (World Health Organization, 2020).

Words that come from the heart enter the heart.

—The Sages

Many people consider overweight to be primarily a cosmetic issue. Although feeling attractive is important, overweight is a serious health issue. Overweight individuals are predisposed to a variety of illnesses (**Figure 6.1**), including heart disease and type 2 diabetes, which can result in blindness, kidney failure, and nonhealing skin ulcers, and it is the leading cause of nontraumatic amputation in the United States. Because of their large body size, overweight individuals tend to have more job-related injuries and an increased risk of becoming disabled from arthritis, gait disturbances, back pain, and general instability. Overweight also predisposes individuals to *metabolic syndrome*, which is characterized by high body fat primarily located around the abdomen, high blood sugar, high levels of triglycerides, high blood pressure, and the inability to respond to insulin. On average, people who are overweight live several years fewer than healthy-weight age peers. Annually, about 160,000 Americans die prematurely from complications of being overweight. U.S. healthcare costs related to overweight are more than \$190 billion per year.

- Early death
 - Obstructive sleep apnea
 - Snoring
 - Coronary artery disease
 - Surgical risk
 - High blood cholesterol
 - Diabetes (type 2)
 - Cancer
 - Men: Colon, rectum, prostate
 - Women: Breast, uterus, ovaries, gallbladder
- Arthritis
 - Stroke
 - High blood pressure
 - Gallbladder disease
 - Excessive sweating
 - Cirrhosis of the liver
 - Kidney problems
 - Low back pain
 - Gout
 - Varicose veins

Figure 6.1 Health Consequences of Overweight. Overweight and obese people have a greater likelihood of developing certain health problems than do people of normal weight.

© Kali9/E+/Getty Images

Description

The percentage of Americans who are overweight or obese has been increasing steadily for decades ([Figure 6.2](#)). The reasons for this increase in overweight include the following:

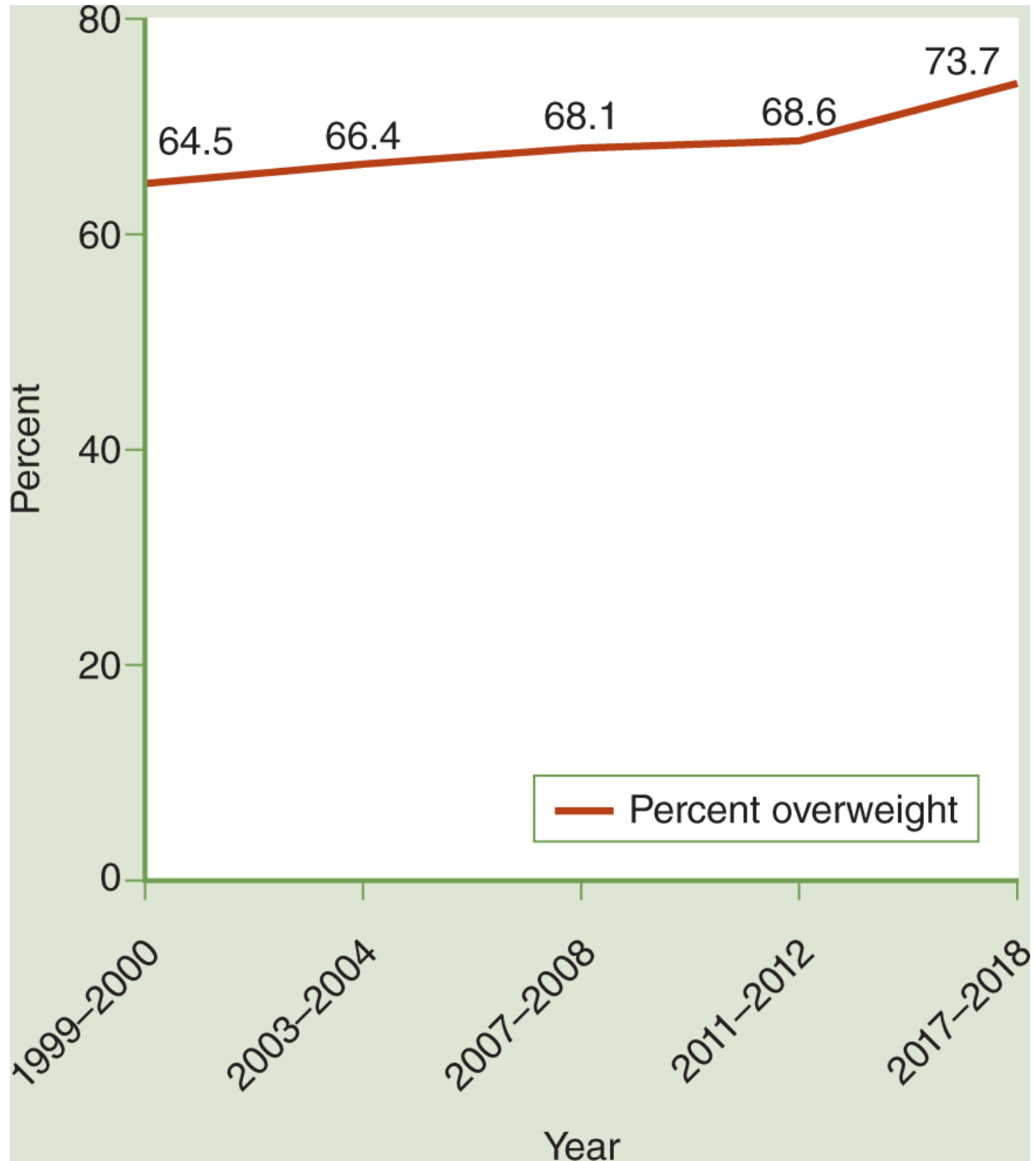


Figure 6.2 Overweight and Obesity in the United States, 1999-2000 to 2017-2018. The percentage of adult Americans who are overweight (BMI >25) or obese (BMI >30).

Data from National Center for Health Statistics. Health, United States, 2019: Table 021. Hyattsville, MD. 2021. <https://www.cdc.gov/nchs/hus/contents2019.htm>

Description

- an overconsumption of calorie-dense foods is related to energy expenditure.

Between 1971 and 2010, average daily energy intake per American man rose from 2,453 calories to 2,564 calories (111 more per day), and per American woman rose from 1,540 calories to 1,803 calories (263 more per day) without a compensatory increase in calorie use through physical activity (Ford & Dietz, 2013).

- an abundance of and the relentless marketing of inexpensive foods contribute to weight gain (highly processed foods and snack foods, sodas, and fast food).

Fast-food consumption (more than twice per week) is strongly associated with weight gain (Rosenheck, 2008). The prevalence of overweight is proportional to the number of residents per fast-food store and the number of fast-food restaurants in a community (Liu, Widener, Burgoine, & Hammond, 2020).

- an increase in portion sizes; for example, in the past 25 years a “regular” soft drink increased in size from 10 to 16 ounces. A “Big Gulp” is 30 ounces.

In the past 30 years, the energy content of fast-food entrées increased 100 calories per serving (McCrory, Harbaugh, Appeadu, & Roberts, 2019).

- a reduction in jobs that require physical labor.
- a decrease in the amount of work and leisure movement activity.

- an increase in suburban living, with an associated reliance on automobile travel rather than walking or bicycling.

One study found that each additional hour spent in a car per day was associated with a 6% increase in the likelihood of obesity, and each additional kilometer walked per day was associated with a 4.8% reduction in the likelihood of obesity (Frank, Andresen, & Schmid, 2004).

- reductions in school physical education and after-school physical activities.
- an increase in time spent watching TV, using the computer or mobile device, and playing video games.
- an increase in the pace of life, which creates a demand for prepackaged and fast food.
- an increase in the stress of life, which fosters eating high-fat, high-sugar “comfort foods,” which can lead to weight gain as part of the metabolic syndrome (Klatzkin et al., 2019).

Among American college students, about 56% of women and 36% of men consider themselves overweight; 53% are trying to lose weight (American College Health Association, 2021). Some of these students may have been overweight when they started college, whereas others gained weight after entering college. Some reasons for weight gain in college include the following:

- being away from home and thus having greater independence in food choices (which may not always be the healthiest);
- fragmented schedules that promote skipping meals, especially breakfast, and the resultant consumption of high-calorie snacks and fast food when hungry;

- little time invested in physical activity because of academic and paid work responsibilities; and
- exposure to factors that promote food consumption—for example, soda and snack vending machines on campus, unlimited access to dorm or dining facility food, and academic and social stress.

Judging from the number of books and magazine articles extolling various “surefire” weight-loss methods and of infomercials peddling dietary supplements and exercise gear, it would appear that the U.S. national pastime is weight control. Indeed, about 17% of adult American women and men are on so-called reducing diets (called that because they generally fail to reduce weight in the long run). Concern about body weight (more typically, body *fatness*) fuels a \$71 billion weight-loss industry.

With all the passion for losing weight, it is no wonder that many people view body fat as an enemy. However, the human body has evolved over time in environments of food scarcity; hence, the ability to store fat easily and efficiently is a valuable physiological function that served our ancestors well for thousands of years. Only in recent decades in primarily industrially developed economies and increasingly developed ones have high-calorie consumable-as-food products become so plentiful and easy to obtain as to cause fat-related health problems. People no longer have to spend most of their time and energy gathering berries and seeds and hoping that a hunting party will return with meat or even plow the back 40 and feed the chickens. Nowadays, all they have to do is drive to the supermarket or a fast-food outlet, where for an especially low cost they can obtain nearly all of their daily calories ([Table 6.1](#)).

TABLE 6.1 | **Percentage of Daily Calories Provided by Typical Fast-Food Meals**

Meal	Calorie Levels (per Day)		
	1,600	2,000	2,500
Quarter Pounder + french fries + milkshake	73	58	47
Whopper + french fries + soft drink	66	54	43
Two slices of pizza. + diet soft drink	33	25	20

Description

Body weight issues are not solely about food intake. They are about food intake in relation to many other factors, including a sedentary lifestyle and lack of movement activities, heredity, advertising of weight-promoting food products, lack of guidance regarding proper nutrition, confusing information about the effects of food on health and well-being, the custom of using body shape as a measure of social desirability, and a hectic, stressful lifestyle. In such a complex environment, the overavailability of cheap, fatty, salty, sugary products allows them to be used for a variety of purposes other than to provide calories when hungry.

Exposure to certain industrial chemicals referred to as *obesogens* may also affect one's susceptibility to being overweight (overfat) by upsetting the body's fat-storage systems (Egusquiza & Blumberg, 2020). For example, obesogens can cause the body to make more fat cells. These cells not only store fat but also manufacture hormones that increase appetite and decrease energy use. Suspected obesogens include bisphenol A (BPA), bis(2-ethylhexyl) phthalate (DEHP), diethylstilbesterol, mono(2-ethylhexyl) phthalate,

perfluorooctanoic acid, tributyltin, and triphenyltin. Most obesogens are chemicals used to manufacture plastics; others are pesticides, wood preservatives, and slime inhibitors in industrial water systems.

In contrast to those who are cautious about overweight, some—almost always men—are concerned about perceived underweight. Although not unhealthy, they imagine themselves to be less attractive and masculine and desire to gain several pounds of muscle. Many men who want to gain weight think that women prefer men who are much more muscular than these men perceive themselves to be. However, women generally prefer men with ordinary body sizes without added muscle. There are biological limits to how muscular one can become. One can try to maximize one's potential for muscularity by engaging in strength training and consuming healthy foods to support that activity. Special diets of so-called superfoods and supplements in and of themselves will not produce increased muscularity, advertising claims notwithstanding. And drugs that are purported to bring about weight (muscle) gain are either worthless (chromium, creatine, protein powders) or dangerous (ephedra, anabolic steroids).

What is Healthy Weight?

In most instances, concerns about being overweight are really concerns about being *overfat*. There is a difference. Some professional male athletes, for example, weigh much more than the recommended weight standards for persons of similar height. Yet as little as 1% of their body weight may be fat. Most of the nonwater body weight of a well-conditioned athlete is muscle and bone. Female body builders, who are the leanest of all female athletes, have about 8% to 13% of their total body weight as fat. This probably represents the lower limit of fat for a healthy woman.

Body fat is composed of two parts: **essential fat**—fat necessary for normal physiological functioning, such as nerve conduction—and **storage fat**. Essential fat constitutes about 5% to 10% of body weight in men and about 8% to 15% of body weight in women. This sex difference, which is presumably caused by hormones, results from the biologically based deposition of greater amounts of fat on the hips, thighs, and breasts in females. Storage fat, also called *depot fat*, constitutes only a small percentage of the total body weight of lean individuals and 5% to 25% of the body weight of the majority of the population. **Obesity** is the medical term for storage fat exceeding about 30% of body weight.

Social standards for the most “desirable” or “ideal” body weight or body composition (fat percentage) vary. For example, in some cultures, women with significant storage fat are considered physically attractive and sexually desirable, and fatness in children is considered a sign of robust health. In North America, attitudes about desirable adult body configuration fluctuate over time and are often keyed to fashion trends. In the 1920s, the ideal female body shape was “tubular,” with emphasis on small breasts and slim hips. In the 1950s, the ideals were a large body size characterized by “full-figured” women and “he-men.”

Today, the ideal female body shape is “hourglass,” with emphasis on ample breasts and hips and a small waist (e.g., a *Shape* magazine cover model); the male ideal is slim and muscular with visible, taut (“six-pack”) abdominal muscles (*Muscle and Fitness* magazine cover models).

Health-related body weight is gauged by health professionals and scientists with the **body mass index (BMI)**, which is calculated by dividing a person’s weight in kilograms by his or her height in meters squared (**Table 6.2**). Studies show that good health is associated with having a BMI between 19 and 25 (**Figure 6.3**). People with BMI greater than 25 have higher risks for type 2 diabetes, gallbladder disease, varicose veins, arthritis, heart disease, stroke, high blood pressure, breathing problems, and accident proneness (because of a large body). People who are extremely overweight often face stigmas such as job discrimination and lower social acceptance, and they tend to have lower self-esteem.

TABLE 6.2	Body Mass Index (BMI) Table
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BMI	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Height	Weight (in pounds)																
4'10" (58")	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167
4'11" (59")	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173
5' (60")	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179
5'1" (61")	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185
5'2" (62")	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191
5'3" (63")	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197
5'4" (64")	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204
5'5" (65")	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210
5'6" (66")	118	124	130	136	142	148	155	161	167	173	179	186	192	198	204	210	216
5'7" (67")	121	127	134	140	146	153	159	166	172	178	185	191	198	204	211	217	223
5'8" (68")	125	131	138	144	151	158	164	171	177	184	190	197	203	210	216	223	230
5'9" (69")	128	135	142	149	155	162	169	176	182	189	196	203	209	216	223	230	236
5'10" (70")	132	139	146	153	160	167	174	181	188	195	202	209	216	222	229	236	243
5'11" (71")	136	143	150	157	165	172	179	186	193	200	208	215	222	229	236	243	250
6' (72")	140	147	154	162	169	177	184	191	199	206	213	221	228	235	242	250	258
6'1" (73")	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265
6'2" (74")	148	155	163	171	179	186	194	202	210	218	225	233	241	249	256	264	272
6'3" (75")	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279

Directions: Find your height in the left column. Go across the row to find your weight. Go up the column to the top row to find your BMI. Healthy BMI = 18–24.99; overweight BMI = 25–29.99; unhealthy BMI ("obese") = 30+.

U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. Body Mass Index Table 1. Retrieved from http://www.nhlbi.nih.gov/health/education/lose_wt/BMI/bmi_tbl.htm.

Description

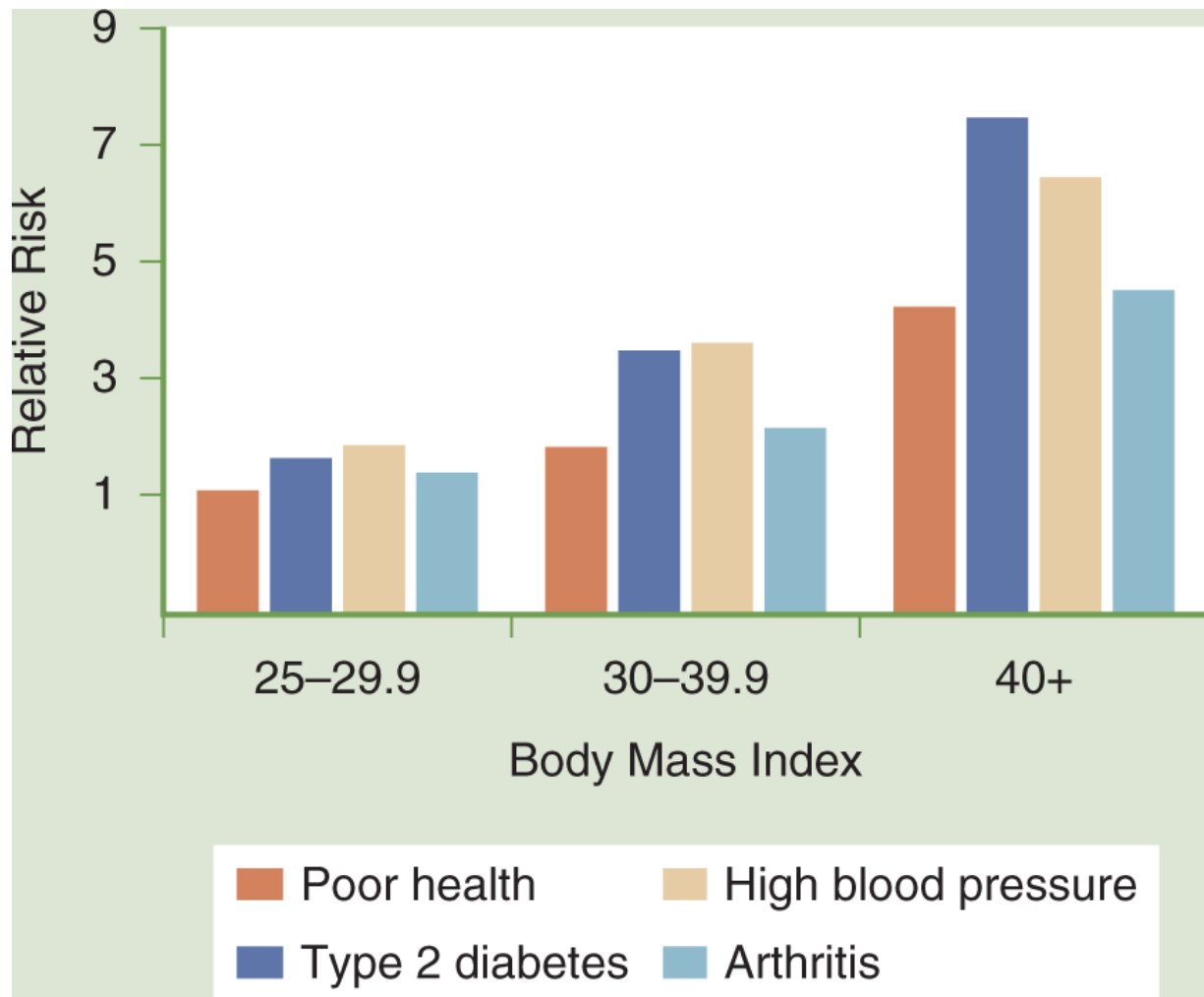


Figure 6.3 Relative Health Risks of Various Body Mass Indexes. The risks for poor health, type 2 diabetes, high blood pressure, and arthritis increase as body mass index increases. Relative risk means that the risk for each BMI is standardized to the BMI range of 18.5 to 24.9, which is considered healthy.

Data from Mokdad, A. H., et al. (2003). Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001. *Journal of the American Medical Association*, 289(1): 76–79.

Description

Another health-related index of body size is the waist-to-hip ratio, which is calculated by dividing the circumference at the waist by the circumference at the hips. For example, someone with a 28-inch waist circumference and 37-inch hip circumference would have a waist-to-hip ratio of 0.75. Health problems are less likely in women whose waist-to-hip ratio is less than 0.8 and in men whose waist-to-

hip ratio is less than 0.95. In other words, it is healthier for a body to be pear-shaped than apple-shaped, and it's healthier *not* to have a beer belly (**Figure 6.4**). Doctors sometimes use only the waist circumference as an indicator of health risks associated with being overweight. A waist circumference greater than 40 inches in men and 35 inches in women is associated with greater health risk.

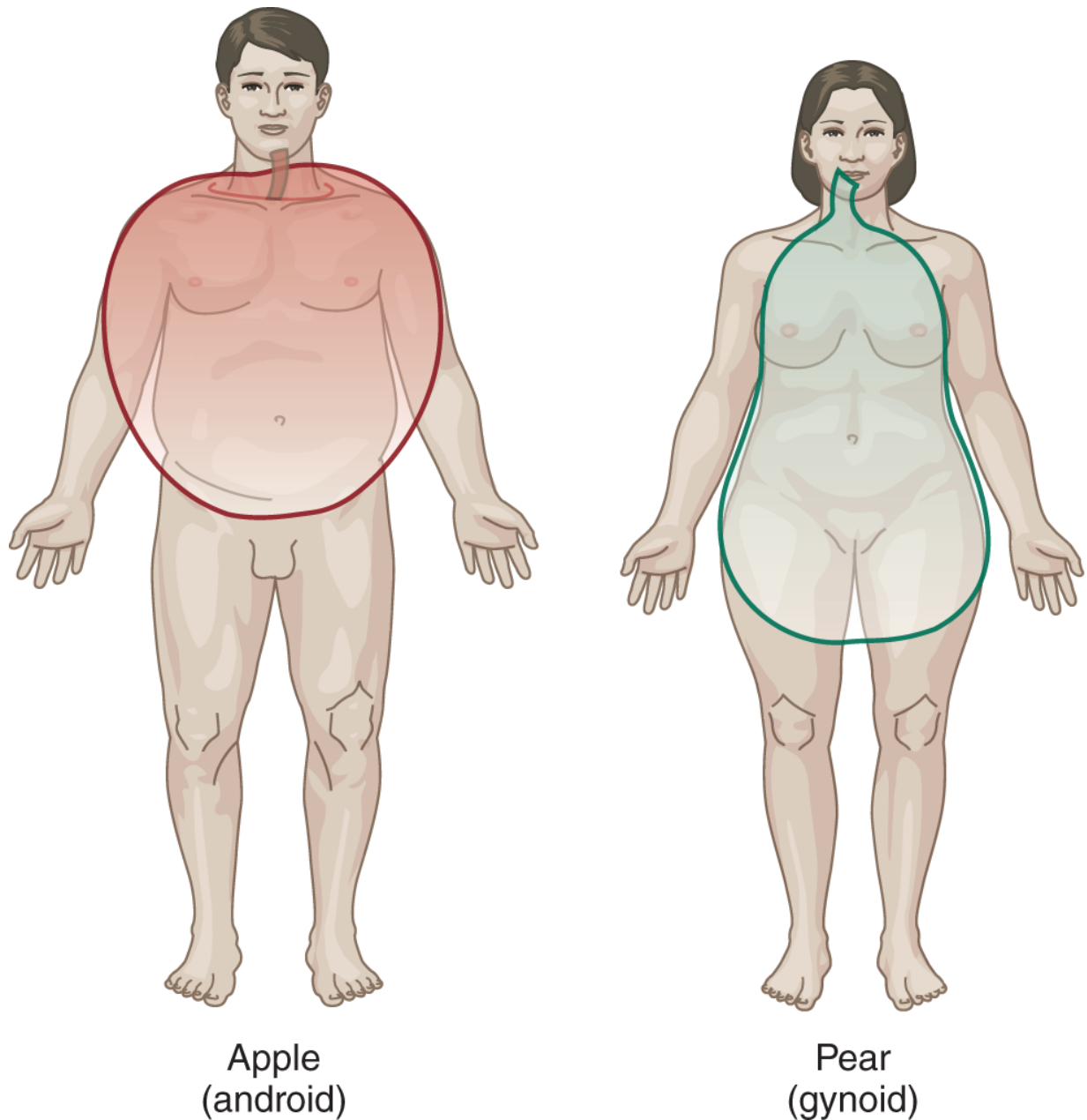


Figure 6.4 Apple or Pear? Apple-shaped people carry much of their body fat above the waist. Pear-shaped people carry their body fat on the hips and thighs. Studies show that it's

healthier to be pear-shaped than apple-shaped.

Description

The Regulation of Body Fat

The body has a multifaceted, complex system for acquiring and storing the energy for life. The body acquires its energy from food: 4 calories per gram of protein or carbohydrate, 7 calories per gram of alcohol, and 9 calories per gram of fat. Calories leave the body as energy expended to fuel basal (resting) metabolism, digestion, physical activity, growth, injury repair, and to maintain body temperature. Calories from food that are not used right away are stored either as glycogen, a complex carbohydrate that is found in liver and muscle, or as **triglyceride**, a fat that is found in adipose tissue located on the body in all-too-familiar places. At 9 calories per gram, fat is the most efficient form of energy storage (1 pound of fat will fuel a 40-mile walk), and fat has other biological advantages: it's lightweight, compact, spongy, and a good thermal insulator.

The body's energy-acquisition system has two main components: the homeostatic eating system and the hedonic, or pleasure, eating system. The **homeostatic eating system**, controlled in the hypothalamus region of the brain, maintains a relatively constant level of body fat. When energy levels fall, either from utilizing food attained in recent meals or by mobilizing energy stored as fat, the body signals that deficit to the brain via certain hormones, which triggers hunger, which motivates eating. When energy (fat) levels are restored, the body signals that situation to the brain, which creates the feeling of fullness (called *satiety*). That causes sensations of hunger to lessen and attention is turned to other matters.

The level of body fat maintained by the homeostatic eating system is determined by heredity and developmental influences and is relatively constant over time; it is sometimes referred to as the *body weight set point* or *fatness set point*. If a person eats more than usual in a short period of time and gains several pounds of weight (fat), for example, while vacationing on a cruise ship, when the person returns to usual life the brain automatically reduces hunger

and appetite, the person eats less without thinking about it, and the extra weight is shed until the set point weight is attained. Alternatively, if a person uses more energy than usual in a short period of time and loses several pounds of fat, for example, by being extremely sick for 3 weeks, when healthy again the person will eat more without trying to and in a few weeks body weight will return to the set point.

Unlike the homeostatic eating system, which responds to levels of nutrients and energy in the body, the **hedonic eating system**, also called the *pleasure eating system*, responds to food-related thoughts and emotions that are independent of hunger. For example, you can walk into the mall and smell freshly baked chocolate chip cookies and not resist consuming one or more even if you have just eaten and are full. Or you can go to a restaurant with friends or eat dinner with your family at “dinnertime” even if you are not hungry. On the other hand, you could be hungry, but you really dislike the pizza toppings your friends have ordered and you lose your appetite. Or you invite a new love interest to dinner and are too distracted by your emotions to eat.

The hedonic eating system is centered in a network of nerve cells located in various regions of the brain that are involved in reward (feeling good when you get what you desire) and deprivation (feeling bad or craving when you don't) (Yu et al., 2015). Rather than being governed by built-in biological mechanisms for maintaining levels of energy and nutrients, hedonic eating is motivated by the psychological desire to experience a certain kind of pleasure, most often associated with consuming so-called **palatable foods**, which create the sensations of salty, fatty, and sweet.

Hedonic eating is the body's way of “saving for a rainy day.” Even if you're getting enough food to keep you healthy and aren't often hungry, hedonic eating takes advantage of opportunities to fatten up in case you encounter a lengthy time of food scarcity. However, when food is abundant and easy to attain (as in most economically developed and developing countries), hedonic eating is responsible for many, many people being overweight (overfat) and susceptible to the diseases that result from it, social stigma for being perceived as

lazy and gluttonous, and self-doubt. Also, because hedonic eating is not governed by the level of energy in the body, it can be put to other uses—for example, to avoid thinking about one's problems or to feel socially accepted by friends and family by happily consuming the same kinds of foods they do (Boggiano et al., 2015). Nicknames for psychological and social motivations for hedonic eating include *emotional eating*, *stress-induced eating*, *food addiction*, *eating comfort foods*, *medicating with food*, and *grazing*. As long as you are generally healthy, your homeostatic eating system is working properly, *and you pay attention to it* when it signals fullness. You are unlikely to develop a weight (fat) problem because your homeostatic eating system will ensure that your calorie intake will pretty much equal your calorie output; this is called being in a state of **energy balance**. However, you only have to exceed energy balance a little bit to develop a weight problem over time. Consider this example:

Marci is a 26-year-old woman of normal weight with a BMI of 23 who recently changed jobs. Previously the office manager in a small real estate company, she now works as an executive assistant in a much larger firm. Two consequences of this change are (1) Marci now spends more time sitting at her desk computer and answering the phone than in her former job, where she moved around to do virtually every office task; and (2) she now goes to lunch with office mates. The combination of less movement and restaurant lunches has increased Marci's daily calorie intake over expenditure an average of 10%.

What's 10%? For Marci, that's about 160 calories per working day, or 3,200 calories a month. Because a pound of body fat has 3,500 calories, that's enough for Marci to gain about 10 pounds per year. You can see what a few years at this job might do to Marci's waistline. When the office crew goes to lunch, often their intention is to socialize and get away from the stress of the office; they don't intend to consume lots of food. However, the desire to be social, the smell of food, and generous portions make it easy to ignore satiety signals from the homeostatic eating signals from the brain and to overeat.

Any healthy man can go without food for two days—but not poetry.

Charles Baudelaire, 19th-century French poet

Of course, Marci could prevent gaining those 10 pounds a year by being more mindful of her lunchtime eating behaviors and walking a few more minutes each day. By consuming one less cookie or half of a 12-ounce soda, she would consume 80 fewer food calories per day. Also, if she parked her car a 10-minute walk from her workplace, she would utilize 80 calories more than usual. Eating 80 calories less and walking off 80 calories more would stop the accumulation of 160 calories of fat per day and those 10 extra pounds each year. If she doesn't eat less and exercise more, however, her body is likely to store those excess calories as fat. Over time, her body will probably adjust to the higher weight as its "new normal" fatness set point, and in a couple of years she is likely to find herself with a BMI near 27 and in need of a new wardrobe. If that happens and she decides to lose that extra fat, she's likely to find that to be a serious challenge.

Why? Because the body doesn't like to let go of fat it has accumulated—or, as scientists say, the body defends against fat loss. Remember, over many thousands of years of evolution, the body has developed the capacity to store fat easily in case you ever have periods of little or no food as your ancient ancestors did. Of course, that almost never happens to people who live in economically advantaged societies, but those built-in, efficient fat-storage mechanisms are still present. So, once fat is deposited in adipose tissue, the body holds on to it. The main ways the body defends against fat loss are to increase the efficiency with which the body uses energy, decreasing the resting metabolic rate and increasing the efficiency with which the muscles do work. Also, even if a person is successful at losing weight, the body responds to the weight loss as if the person's life is in danger from semistarvation and will increase hunger and appetite to recover that lost weight.





If you have to snack, choose healthy foods such as fruits and vegetables.

© Anton Albert/Shutterstock

Generally, sensible and consistent weight-loss efforts produce a 5% to 10% reduction in body weight (fat) over the first 6 months of trying, with no further weight loss after that. This is the reason that people are encouraged not to gain weight in the first place. Fortunately, even a 3% reduction in body weight (fat) can significantly improve health status even though reduction in body size is not significant.

Calorie-Restriction Diets Rarely Work

To a nutritionist, the word *diet* means what an individual usually eats and drinks. To almost everyone else, the word *diet* means restricting calories or eating unusual foods to lose weight, as in “I’m on a diet.”

It’s logical to think that consuming less food than usual will produce weight loss because overeating is generally identified as the reason for weight gain. Although logical, consuming fewer calories than usual works only in medically supervised weight-loss programs or when people are in a continuous state of near starvation—for example, in environments where food is chronically scarce. When living in an environment in which food is plentiful, however, people are unable *not* to eat what they want for long because semistarvation turns on biological and psychological mechanisms designed to conserve both body fat and energy expenditure, and being hungry and craving your favorite foods is no fun. Whereas calorie-restriction diets initially tend to be moderately successful, resulting in a loss of a few pounds in the first few weeks, within a few months after the diet begins, the body resists further weight loss even if the calorie-restriction is maintained (**Figure 6.5**).

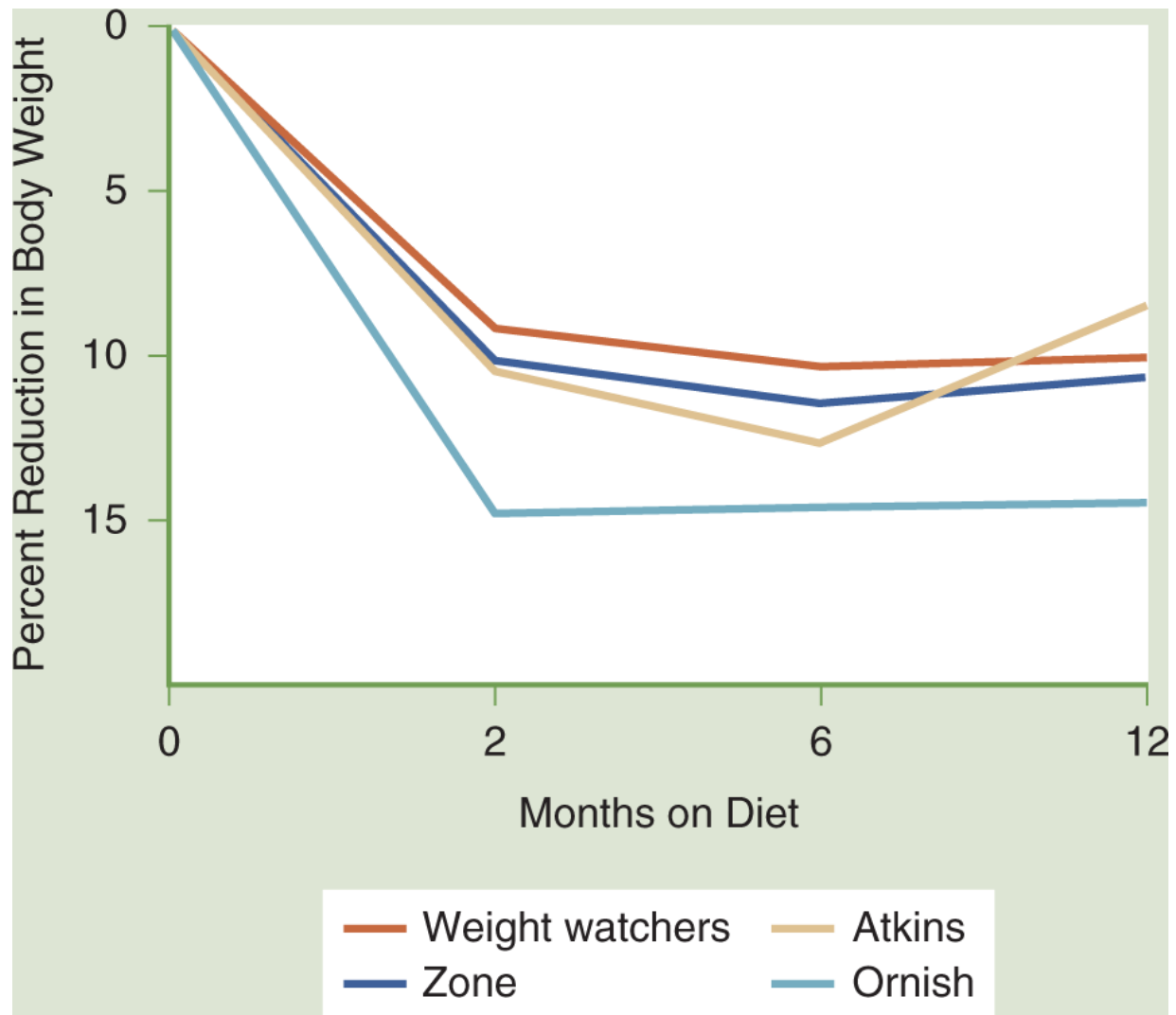


Figure 6.5 Weight Loss from Adherence to Several Popular Diet Programs. The Ornish diet is vegetarian.

Data from Dansinger, M. I., et al. (2005). Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction. *Journal of the American Medical Association*, 293, 43–53.

Description

Besides the fact that the body defends against weight (fat) loss, calorie-restriction diets fail for the following reasons:

- Dieters focus on food and not on increasing physical activity. Increasing energy expenditure, rather than decreasing energy

intake, is the key to successful weight loss and long-term healthy weight management.

- Because continued adherence to a calorie-restricting plan does not produce commensurate reduction in weight loss, dieters become disillusioned and discouraged and stop following the plan (**Figure 6.6**). Moreover, any weight lost while on the diet tends to be regained. Among those who lose weight by restricting calories, about 50% regain the lost weight within 1 year after stopping the diet, and nearly all regain the lost weight within 4 years.

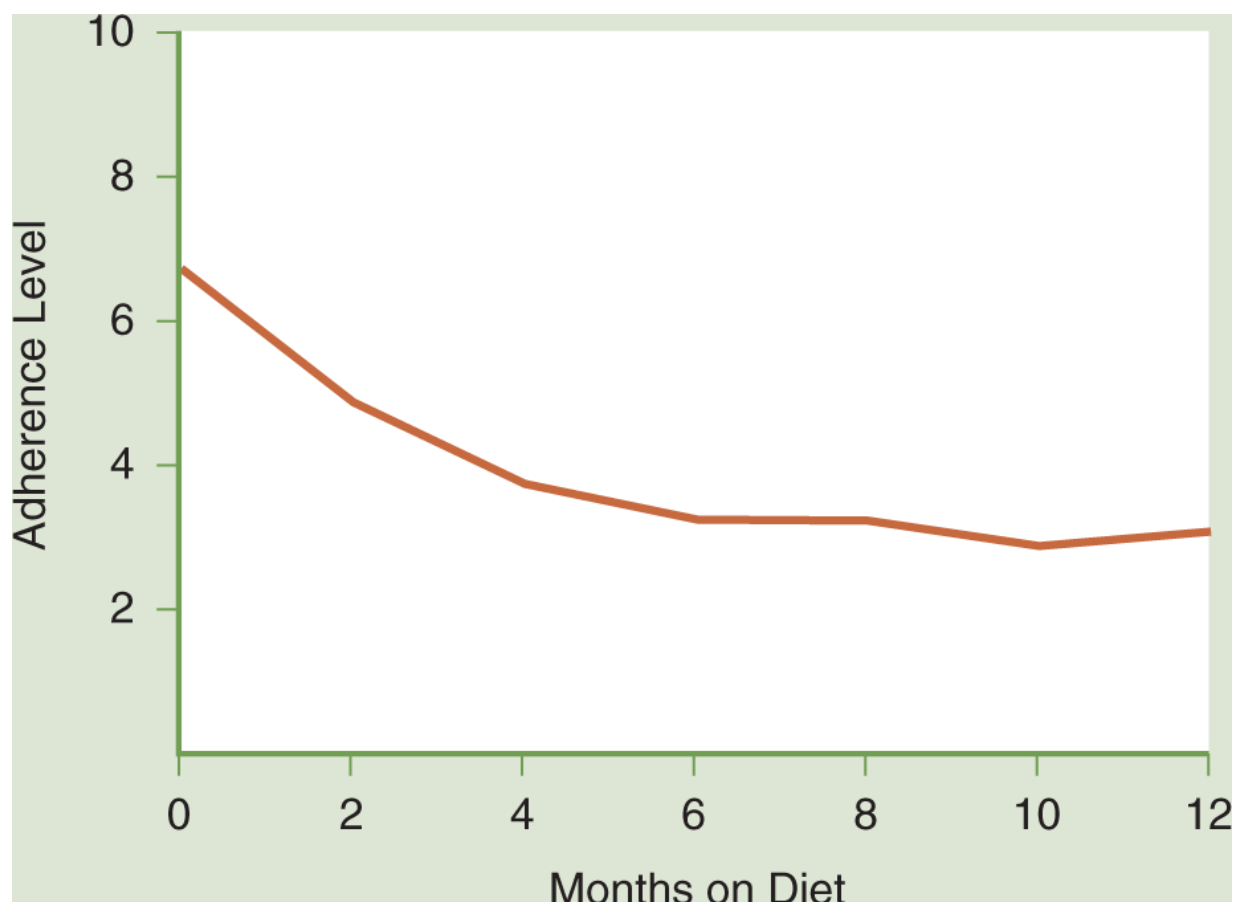


Figure 6.6 Adherence to Popular Weight-Management Diets. Dieters' self-reports show a gradual decline in adherence to a weight-management diet over 12 months. This pattern is similar for the Atkins, Zone, Weight Watchers, and Ornish diets.

Data from Dansinger, M. I., et al. (2005). Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction. *Journal of the American Medical Association*, 293, 43–53.

Description

- Dieters become bored eating the same required foods. This is especially true of diets recommending principally one kind of food (e.g., liquid diet programs, grapefruit, steak, papaya, cottage cheese).
- Dieters become frustrated not being able to eat the kinds and quantities of foods they prefer.
- Dieters are constantly hungry. They become obsessed with food. They even dream about food.
- Prepackaged, special diet foods can be expensive.



Self-Care: Fast-Food Research

Each day approximately 40% of the U.S. population consumes restaurant fast food. The reasons for patronizing such establishments are convenience (they are everywhere), perceived lack of time to shop and prepare meals at home, fast food's taste and texture, the need to mollify nagging children, and cost. Because fast food is so popular and prevalent, it is healthful to know the nutrient content of the fast food you consume.

Instructions

1. Obtain from the restaurant's website or printed brochure the components of its products.
2. Choose a fast-food meal that is typical for you and list the meal's components (grams of protein, fat, saturated fat, cholesterol, added sugar, fiber, and mg salt). Calculate total calories.
3. Calculate the dollar cost of the energy content of the meal (divide total calories by the total cost). This tells you how much bang (i.e., energy) you are getting for your buck.

4. Refer to the MyPlate website (<https://www.myplate.gov/myplate-plan>) to estimate your required daily calorie intake. Use that value to estimate the percentage of your estimated daily calories contributed by this meal.
5. List the reasons you patronize this establishment.
6. How frequently do you patronize fast-food restaurants?
7. What did you learn from this research?

Note: Fast Food Nutrition Facts (<https://fastfoodnutrition.org/>) lists the nutrient composition of fast foods. Whereas it is possible to analyze the data for this assignment with that web tool, it is more interesting and makes you a better health consumer if you go personally to the restaurant and ask for the data.

Popular Weight-Loss Programs

Popular weight-loss programs generally are of the following types:

- **Low calorie:** These reduce portion size to limit calories consumed. Examples are Weight Watchers, Nutrisystem, Jenny Craig, Optifast, Medifast, and eDiets. The benefit of these programs is that they are balanced nutritionally. The drawbacks are that they produce at best a modest loss of weight (5% to 10% of prediet weight) and the reduction in calories makes people hungry and thus leads to discontinuation of the program.
- **Low carbohydrate:** These reduce intake of breads, rice, pasta, potatoes, sweets, snack foods, and, depending on the plan, vegetables and fruits. To make up for the exclusion of carbohydrate, the programs recommend foods high in protein and fat. Examples are the Ketogenic (Keto) Diet, Atkins, and South Beach programs. The benefit of this kind of eating plan is that it reduces the consumption of refined complex carbohydrates, simple sugars, and high-fructose corn syrup found in packaged, fast, and junk foods. Also, protein and fat tend to reduce appetite more effectively than does refined

carbohydrate. The disadvantage of a low-carb diet is the consumption of high amounts of red and processed meats and associated health risks, and saturated fat, which might raise blood levels of low-density lipoprotein (LDL) and therefore risk of cardiovascular diseases.

- Low fat: These diets recommend high complex carbohydrate and little fat. An example is the Ornish Diet. A major benefit is that the diet is “heart healthy.” A drawback is that in our current food environment, calories from unhealthy refined carbohydrate products are plentiful and heavily marketed, whereas complex carbohydrates from whole grains, fruits, vegetables, and beans are perceived as more expensive than junk and fast food, more difficult to obtain, and less palatable.

When diet programs work, it is generally because they reduce the number of calories consumed and not because of the types and proportions of food consumed. For example, just about any diet plan that delivers approximately 1,450 calories per day represents about a 300- to 700-calorie per day difference between calories ingested and calories expended. This difference can produce a loss of about 1 to 1.5 pounds a week until the body’s weight-loss-resistant mechanisms kick in. Also, any effective weight loss diet must be constructed on a variety of high-quality, nutritious foods (Freire, 2020).

Sensible Weight Management

If calorie-restricting diets by themselves do not produce lasting weight loss, what does? Results from studies in the National Weight Control Registry (2017) show that American adults who lost weight and *kept it off for several years* did so by engaging in an hour of moderate physical activity daily; consuming five small high-carbohydrate, low-fat meals or snacks; regularly monitoring their weight and exercise activities; and virtually never eating fast food (Dennett, 2019). Many studies have shown that significant safe weight loss is associated with limiting calorie intake to 1,200 calories per day for women and 1,500 calories per day for men, limiting fat consumption to less than 30% of calories, consuming recommended amounts of dietary fiber, engaging in physical activity at least 150 minutes per week, and getting involved in counseling or group support (Ramage, Farmer, Eccles, & McCargar, 2014). Maintaining weight loss is associated with continued application of weight-loss knowledge and skills, continued weight vigilance, and long-term lifestyle changes, especially calorie control, regular physical activity, and professional guidance.



Although most people want to feel good about their bodies, advertisements often portray unrealistic images that can lead to unhealthy diets and eating habits.

© Jones & Bartlett Learning. Photographed by Lian Bruno

Rather than adopting unusual weight-loss regimens in the search for the “ideal” body size, sensible and successful weight losers live healthfully and let their bodies find the weight that is right for them, which involves the following:

- *Forget slim, go for health.* Images in media and advertising suggest that a healthy body is slim and muscular. However, a variety of body sizes, shapes, and fat compositions are healthy. For example, someone who is 5 feet 4 inches tall can weigh between 110 pounds (BMI = 19) and 148 pounds (BMI = 25) and still have a healthy body weight.

- *Set realistic goals.* A major obstacle to weight loss is setting a goal of attaining a youthful, former, slim body size—and quickly. Because the body resists fat loss, with patient adherence to a sensible plan, most people can expect to lose about 5% to 10% of their body weight, which, although probably not sufficient to return them to slimness, nevertheless will lessen their risks for heart and other serious diseases, and result in feeling better. Everyone must realize that stereotypes of attractiveness can be especially difficult to attain without a predisposing genetic makeup or a visit to the cosmetic surgeon. Sensible weight management involves being aware of social pressures toward unattainable goals and not succumbing to advertising and fashion trends.
- *Eat only when hungry and don't overeat.* Use a food diary (see Chapter 5 Food Diary Box) and pay attention to hunger and satiety signals from your body. Be aware of habits and customs that influence your eating behavior: Do you eat at predetermined times of day (mealtime, between classes, on the way to work) regardless of your state of hunger? Do you eat *everything* on your plate? Do you work or study while eating and vice versa? Be aware of satiety signals from your body. Can you say to yourself, "That's enough for now"?
- *Eat healthy foods.* Base your diet on whole-grain foods, beans, nuts, and fresh fruits and vegetables. This will add nutrients to your diet and limit the consumption of calorie-laden, nutritionally inferior fast food and junk food.



Walk the Walk

Count the number of steps you take each day using a pedometer, accelerometer, fitness monitor, or smartphone app. Shoot for 10,000 steps per day (about 5 miles).

- *Exercise.* Move your body around for at least 30 minutes per day, four to five times a week. Sixty minutes is better. You don't have to work out in a gym or engage in any activity in which you breathe hard and sweat (**Table 6.3**). Take a walk. Use a standing desk (**Figure 6.7**). The goal is simply to expend energy by moving your body. Even nonexercise movements such as standing, toe tapping, walking from room to room, talking, and fidgeting can utilize significant amounts of energy during the day (Villablanca et al., 2015). And don't subscribe to the myth that exercising will increase appetite and food consumption. In fact, except for individuals who expend enormous amounts of energy (e.g., lumberjacks, football players), the opposite is true. Appetite and food consumption tend to decrease as physical activity increases (Thackray, Deighton, King, & Stensel¹, 2016).

TABLE 6.3	Nongym Ways to Increase Physical Activity
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Take stairs whenever possible.

Count steps with a pedometer; aim for 10,000 steps a day (15,000 is better).

When feasible, park your car so that you walk 10 minutes to and from your final destination.

Get off of public transportation and walk 10 minutes to your destination.

Walk 20–30 minutes on lunch break.

Exercise or walk with friends or in a group.

Stretch for 5 minutes while on a break at work or before bed.

Strengthen muscles (isometrics, push-ups) 2–3 times a week.





Figure 6.7 A NEAT Desk.

Courtesy of Mayo Clinic.

- *Limit mindless snacking.* Mindless snacking is the kind we do when we are ravenously hungry, stressed, surfing the web, on social media, or zoned out watching TV. We wish that bag of chips were bottomless. TV advertisers encourage mindless snacking. They know that when you're watching TV you're in a state of autohypnosis, and they bank on your susceptibility to their images of beer, snack foods, candy, and soft drinks. Ignore them. Instead of mindless snacking, it's better to focus on the food you are eating.

NEAT stands for *nonexercise activity thermogenesis*. This is energy you use while doing regular activities such as sitting, talking on the phone, walking, and reading. While doing their daily activities, some people more than others have a propensity to move parts of their bodies. They fidget, wiggle, tap their fingers and toes, and take breaks to move and stretch. It turns out that these folks can utilize several hundred calories of energy doing these NEAT movements, and they rarely have a weight problem.



Mindful Eating

Eating should be a relaxed, pleasurable activity but is rarely that in our hectic daily lives. We eat on the run or take only enough time to grab a bite. Most teenagers polish off a full plate of food in a couple of minutes. Just as taking time for physical activity is important for your body, so is taking time with your meals. You can begin to break the habit of wolfing down your food by practicing *mindful eating*.

Practice this mindful eating exercise every day until you feel that you have become more aware of your food and the nourishment you receive from it.

Start by choosing a small piece of food—perhaps a grape, slice of carrot, or a piece of dried fruit. Sit quietly and slowly place the food in your mouth. Pay attention to its texture and flavor.

Begin to chew it slowly and notice the response in your mouth—how your saliva starts to flow and how your jaw is moving. Chew until you feel ready to swallow; pay attention to the process of swallowing.

When you eat a meal, focus all of your attention on the food and the satisfaction of eating. Do not read or watch TV while eating. Make eating a quiet, pleasurable occasion. Do not bring problems or arguments to the table. By eating slowly and quietly you also will hear the message from your stomach when it is full. Listen to the message and stop eating.

Mindful eating can be a powerful technique in weight control and limiting the consumption of food that your body does not need.

The propensity for “NEATness” is probably genetic, but it is something that a non-NEAT person can do. For example, walk in place or around the room when on your phone or when having an in-person conversation. Choose the longest, responsible route when going from here to there. Take a lap around the office a few times a day; set the alarm on your phone to remind you. Do the same at home when plugged into a screen. At work, suggest installing carpet tape to delineate a walking track to transform sitting meetings to walking meetings. Use a stand-up desk with or without a treadmill or stationary bike. Use an underdesk cycle. Have (and use!) stretch bands or a flex-resistance bar at your desk (or near your couch!).

- *Consume little or no alcohol.* Alcohol contains 7 calories per gram (about 100 calories per 12-ounce beer, 4-ounce glass of

wine, or one shot of distilled liquor). A couple of beers per day without a compensatory reduction in food intake or increase in exercise could lead to an excess of body fat rather quickly.

- *Be aware of eating triggers.* Many of us are susceptible to environmental cues that trigger eating. For example, some people cannot pass a candy or soft-drink machine without feeding it money in exchange for it feeding them. At some worksites, well-meaning supervisors and coworkers provide pastries and candy for staff members, who may have difficulty resisting, especially when stressed or fatigued.
- *Don't feed your feelings.* Stress, anxiety, loneliness, boredom, fatigue, and anger can motivate overeating. Many people derive emotional comfort from food. One possible explanation is that as children, we learn to associate eating (particularly nursing as infants) with receiving love, affection, and comfort. Another possibility is that when we consume certain foods, particularly those containing sugar and fat, they alter brain chemistry and contribute to feelings of calm.

The energy equivalent of 1 pound of body fat is 3,500 calories. If you want to adopt a weight-reducing program that results in a loss of 1 pound a month, plan your dietary and physical activities so you can produce a net daily deficit of 120 calories. Walk a little more each day or cut out a soft drink or a couple of cookies. If you want to lose 1 pound a week, plan for a net daily deficit of 500 calories that includes at least a 300-calorie expenditure per day of exercise (**Table 6.4**). The number of calories is not nearly as important as *making a plan to which you can realistically adhere over the long haul*. Here are some other suggestions:

TABLE 6.4 | **Approximate Energy Expenditures During Various Activities**

Light Exercise (4 Calories per Minute)	Cycling 5 mph	Slow dancing	Table tennis
	Walking 3 mph	Volleyball	Yoga
	Canoeing	Softball	T'ai chi ch'uan
	House cleaning	Golf	
Moderate Exercise (7 Calories per Minute)	Tennis	Basketball	Snowshoeing
	Fast dancing	Swimming 30 m/min	Walking 4.5 mph
	Cycling 9 mph	Heavy gardening	Roller skating
Heavy Exercise (10 Calories per Minute)	Jogging	Mountain climbing	Skiing
	Climbing stairs	Cycling 12 mph	Ice skating
	Football	Handball and racquetball	

Description

- Keep a diary of your weight-loss activities and modify things in your plan that do not work.
- Keep faith with your intention to attain a healthful weight. Don't let the inevitable setbacks demoralize you.
- Don't slavishly count calories or constantly weigh yourself; focus on developing healthy behaviors and feeling good.
- Ignore weight-loss and exercise-machine advertising.



Uncle Joe's Successful Weight Loss

Joe had a heart attack at age 55 and needed quadruple-bypass surgery to save his life (see Chapter 10). Joe is 5 feet 7 inches; at the time of his heart attack, he weighed 225 pounds (BMI = 35). Joe wasn't always big. He says he got that way from 30 years of the near daily ritual of meeting up with buddies after work at the local tavern for a few beers and a kielbasa (or two) before going home for dinner.

After his surgery, Joe retired from work as well as from his visits to the tavern. His wife tossed out all of the junk food in their house and put them on a healthy diet. Like a tough drill sergeant, she got Joe out of bed early each morning for a 5-mile couple walk-talk around their town—rain, sleet, or shine. In a couple of years, Joe had achieved his current weight of 155 pounds (BMI = 24). He looks and feels great, and his wife is grateful she didn't become a widow.

Joe is like a lot of people who have succeeded at healthy weight loss. He gave himself lots of time to develop new health habits, and he was diligent about adhering to them. He accepted help, encouragement, and support from his wife, children, friends, and his doctors. Joe not only looked and felt better but also felt good about himself for accomplishing an important goal and making it possible for him and his wife to have a long, enjoyable retirement together.

Besides being good for you, altering your lifestyle to maintain a healthy body weight is also good for the planet. Instead of driving or riding in a car for short trips, if all Americans between ages 10 and 64 walked or biked for 30 minutes a day, not only would they collectively shed 3 billion pounds and eliminate the current epidemic of overweight but also lessen annual carbon dioxide emissions in the United States by 64 million tons, and 6.5 billion gallons of gasoline would be saved (Higgins & Higgins, 2005).

Assisted Management of Overweight

Managing body weight is principally a matter of adopting healthful living habits: eating whole-grain foods and fresh fruits and vegetables, limiting consumption of fast foods and junk foods, and increasing movement. Still, some people cannot successfully manage weight on their own, and they may benefit from seeking the help of a health professional. Methods that health professionals employ to help people reduce and maintain body weight include psychological counseling, hypnotherapy, medications, liposuction, and surgery.

Counseling and Hypnosis

Counseling for weight loss involves helping individuals examine the reasons for their unhealthful eating and exercise behaviors and developing ways to behave more healthfully. Hypnosis has been shown to increase the benefits of counseling. Counseling for weight loss and maintenance focuses on the following (Wadden, Butryn, Hong, & Tsai, 2014):

- Increasing one's self-awareness of the inner dialogue that contributes to the weight problem; for example, changing the thought "I've had a bad day so I deserve a treat; I'll have some fries" to "I deserve a treat; I'll take a soothing bath."
- Keeping records of eating and exercise activities in order to assess current behavior and target personal and environmental changes.
- Changing the environmental factors that trigger overeating and underexercising—for example, not having a full cookie jar on the

kitchen counter or not going out for fast food with friends when the goal is socializing rather than sating hunger.

- Educating yourself about healthy nutrition and physical activity.
- Setting realistic weight-management goals and adopting feasible plans for accomplishing them.
- Teaching about “feeding one’s feelings” and the tendency to eat when feeling stressed.
- Providing social support for weight-management activities.
- Identifying and managing mental health issues, such as depression and anxiety, that may be associated with weight issues.

Psychological counseling is generally effective in facilitating weight loss of about 1 pound a week and a significant percentage of the initial body weight, and it promotes weight-loss maintenance for several months after treatment ends (Bray et al., 2018).

Medications

Several medications have been approved by the Food and Drug Administration (FDA) for medically supervised weight loss. These include appetite suppressants and a drug that blocks the absorption of fat from the intestines (orlistat). Medications can result in the loss of about 5% of initial body weight after several months. Continued use can help retain that degree of fat loss but tends not to produce further loss. Weight-loss medications carry a variety of unpleasant side effects that often lead to discontinuing use and regaining the lost weight. This is why health professionals consider medications to be an adjunct to lifestyle modification (diet, exercise, and greater awareness of eating habits) and not to be used alone to achieve weight loss.

Weight-Reduction (Bariatric) Surgery

Weight-reduction surgery or **bariatric surgery** is for people with a BMI over 40 or with a BMI between 35 and 40 who have severe weight-related medical conditions, such as heart disease or type 2 diabetes, and who have not responded to supervised diet and exercise regimens or drug therapy. There are several methods of weight-loss surgery. Some involve constricting the stomach to make the person feel full after having consumed small amounts of food. Other methods involve surgically restructuring the gastrointestinal tract so that only a fraction of the food ingested in a meal is absorbed into the body and the activities of some of the nerves and hormones that control eating and metabolism are altered.

Bariatric surgery is not cosmetic surgery to produce a particular body size and shape. Its aim is to lessen the amount of food the body processes and to alter the physiological mechanisms that manage energy balance. On average, bariatric surgery produces a long-term loss of 50% to 70% of presurgery body weight and establishes a much healthier metabolism, for example, considerably reducing the risk of type 2 diabetes. Weight reduction from bariatric surgery can last for several years. About 230,000 weight-reduction surgeries are performed in the United States each year.

Liposuction

Liposuction is the surgical removal by suction of fat stored under the skin and is not recommended as a substitute for proper diet, exercise, and counseling for weight loss and weight management. It is for shaping the body. Indeed, after the surgery, without attention to diet and exercise, fat may appear on other parts of the body, and in time, patients actually may gain weight. Annually, more than 200,000 liposuction procedures are performed in women and men in the United States by plastic surgeons, dermatologists, and other physicians. Liposuction is associated with many risks; anyone considering it should investigate the procedure thoroughly. Although rare, deaths have occurred from liposuction.

Weight-Control Fads and Fallacies

“Lose weight effortlessly, even as you sleep!” “New diet discovery lets you lose excess pounds in just one week!” So claim advertisements for products and eating regimens that are directed to chronic dieters and others concerned about being overfat. Some products, such as “diet rings” and weight-loss soaps, are clearly worthless, but some overweight people are so desperate they will try anything.



Treating the Underlying Emotional Causes of

Obesity

Mrs. Johnson made an appointment with a psychologist to discuss being overweight. She was 40 years old, 5 feet 5 inches tall, and weighed 180 pounds. She worked as a nurse at a community hospital and had no serious medical problems. She was married, but her husband had lost his job, and they had three teenage children at home. Her take-home pay was modest, and the family had difficulty paying bills. She ate mostly junk food and fast food and did not exercise.

Because appropriate weight depends on both a healthy mind and body, the psychologist helped Mrs. Johnson discover the stress and negative emotions that were contributing to the weight problem. They included job or family stress, depression, anger, loneliness, and boredom.

Social aspects of being overweight were also explored. What were the barriers to obtaining healthy food? Did her job require a lot of travel or sitting for extended periods? Together they explored how exercise could be incorporated into her daily life.

Mrs. Johnson came to see that she had a high-stress, low-paying job; an unsatisfying marriage; and children at a difficult stage of development. Her life was out of control. With the psychologist's help, Mrs. Johnson adopted a healthy, balanced diet and began walking—and later jogging—in the morning before work. Later, she added weight training to her exercise program. After a few months she obtained a better-paying job with regular hours. She and her husband went to a marriage counselor and the marriage improved. After about a year, Mrs. Johnson's weight stabilized at 130 pounds. She maintained her diet and continued to exercise.

Many overweight people have problems similar to Mrs. Johnson's. Counseling, diet changes, exercise, and social support can help most overweight people who are willing

to make the effort to change their lives.

If slaughterhouses had glass walls, everyone would be a vegetarian.

—Paul McCartney

Unfortunately for consumers, nearly all of the claims made by heavily advertised weight-control regimens and products are exaggerated and misleading. The U.S. Federal Trade Commission (FTC) estimates that weight-loss scams are the most prevalent types of fraud, affecting nearly 5 million Americans per year. By themselves, these are not likely to produce a significant reduction in body fat over any long-term period.

Although totally ineffective, these products are advertised in reputable magazines and newspapers, on TV, and on the Internet, which contributes to their credibility. Something to consider: If any of the products advertised for rapid, effortless weight loss really worked, surely every overweight person would use them and the obesity epidemic would be history. Some popular and largely ineffective weight-loss schemes include body wraps and chemicals and supplements, which are described next.

Body Wraps

Body wraps are hot linens, blankets, saran or plastic sheets, elastic or rubber waist belts, or whole-body garments that are applied in spas or at home, often in combination with herbal compounds, minerals, amino acids, and other substances. Commonly, body wraps promise to open pores to let fat and other toxins escape the body. A wrap designed for just one part of the body (such as the waist or hips) is supposed to reduce the size of just that body region (“spot reducing”).

Body wraps do result in weight loss and a reduction in body size. The catch is that the weight lost is body water and not body fat. The lost body water is quickly regained and so is the lost body weight. Because these products cause a loss of body water, they make dehydration a potential danger. Some athletes have died from exercising while using body wraps.

Chemicals and Supplements

Some products that contain drugs and “natural” substances are sold as weight-loss remedies. Often these products are used in conjunction with calorie restriction, modification in eating behavior, and exercise programs, so they appear effective to the naive consumer. However, no single product by itself has been shown to reduce weight safely and permanently. The FTC has warned consumers about worthless weight-loss scams, including the HCG Diet, L’Occitane skin cream, LeanSpa, and Sensa products. Several types of popular, generally ineffective weight-loss products include the following.

- *Appetite suppressants and energy boosters:* If they actually contain the ingredients listed on the label (because they are unregulated, there is no guarantee they do), these products contain chemicals that act as central nervous system (CNS) stimulants such as ephedra (ma huang), synephrine (bitter orange), and caffeine (guarana, yerba mate). Ingestion of sufficient quantities of a CNS stimulant can result in short-term loss of a couple of pounds. However, these substances have side effects, especially ephedra, which increases the risk of psychiatric, temperature-control, and gastrointestinal problems, and these products have been associated with several deaths. Do not risk your life to lose a few pounds. A related product, *Hoodia gordonii*, a South African plant, is purported to be a

nonstimulant appetite suppressant. It is supposed to act in the hypothalamus to produce a feeling of fullness. No scientific studies have yet found hoodia to be effective. Products containing triatricol, or “triac,” a thyroid hormone–like substance, are marketed as “metabolic accelerators.” Because it can cause heart attacks and strokes, the FDA has banned supplements containing triac. However, triac-containing products are still sold on the Internet along with other thyroid-like chemicals.



Exercise is essential to effective weight management.

© Karkhut/Shutterstock



Inform Yourself: Don't Buy Worthless and

Sometimes Harmful Weight-Loss Products

Nearly all dietary weight-loss supplements that individuals buy in stores and on the Internet are not regulated by the U.S. Food and Drug Administration or the Federal Trade Commission. This means that consumers have no certainty that a product manufacturer's claims about a product's efficacy, safety, and even its ingredients are true. Don't be fooled; dishonest marketers will do just about anything to separate you from your money with false advertising and fake news stories. The FTC is on the lookout for false and fake weight-loss information (<https://www.consumer.ftc.gov/articles/truth-behind-weight-loss-ads>). Here are some FTC tips to help you spot them.

False Promises Ads

- Lose weight without dieting or exercising. (You won't.)
- You don't have to watch what you eat to lose weight. (You do.)
- If you use this product, you'll lose weight permanently. (Wrong.)
- To lose weight, all you have to do is take this pill. (Not true.)
- You can lose 30 pounds in 30 days. (Nope.)
- This product works for everyone. (It doesn't.)
- Lose weight with this patch or cream. (You can't.)

Here's the truth:

- Any promise of miraculous weight loss is simply untrue.
- There's no magic way to lose weight without a sensible diet and regular exercise.
- No product will let you eat all the food you want and still lose weight.
- Permanent weight loss requires permanent lifestyle changes, so don't trust any product that promises once-and-for-all results.
- FDA-approved fat-absorption blockers or appetite suppressants won't result in weight loss on their own; those products are to be taken with a low-calorie, low-fat diet and regular exercise.
- Products promising lightning-fast weight loss are always a scam. Worse, they can ruin your health.
- Even if a product could help some people lose weight in some situations, there's no one-size-fits-all product guaranteed to work for everyone. Everyone's habits and health concerns are unique.
- Nothing you can wear or apply to your skin will cause you to lose weight. Period.

- *Fat burners and fat blockers:* These products claim to oxidize (“chemically burn”) stored body fat or stop the production of body fat. They contain chemicals such as hydroxycitric acid, conjugated linoleic acid, green tea, licorice, pyruvate, vitamin B, and L-carnitine. All of these are generally ineffective. Chitosan, derived from chitin found in crustaceans, is supposed to bind fat in the digestive tract. Studies indicate that this also is ineffective.
- *Bulk-producing agents:* These include methylcellulose, psyllium, and agar. They are supposed to produce a sense of fullness in the gastrointestinal tract, thus suppressing appetite. These agents swell when mixed with water and are much more effective as laxatives than as weight reducers. Glucomannan, a bulk-producing starch derived from konjac tubers, is often touted by health food enthusiasts as a “natural” weight-loss method. There is no evidence that glucomannan or any other bulk producer aids weight loss.
- *Vitamins, minerals, and amino acids:* Vitamins, minerals, and some amino acids (including arginine, ornithine, tryptophan, and phenylalanine) are occasionally sold as weight-loss agents. For example, spirulina, a product made from blue-green algae, is claimed to be effective in reducing weight because it contains the amino acid phenylalanine, which supposedly regulates the body’s appetite. Chromium (generally listed on product labels as chromium picolinate) is supposed to alter carbohydrate metabolism and thus result in weight loss. No studies have ever confirmed this hypothesis. Vitamins, minerals, and amino acids have not been shown to be effective in causing weight loss. And

in especially high doses, some of these substances, although “natural,” can be harmful.



People take hundreds of different herbs, supplements, and other pills to lose weight.

Photographed by Kimberly Potvin.

Body Image

Body image is a person's mental picture of her or his body. Nearly everyone has a body image. Nearly everyone judges that image as good or less good by comparing her or his body image to a standard of the "ideal body" communicated to individuals by their culture and people who are important to them, such as lovers, family, and friends. The judgment a person makes about her or his body image is called *body esteem*. Individuals with a positive body image tend to have higher body esteem than do individuals with a less positive body image.

Whereas maintaining appropriate body size is associated with good health, attempting to achieve an unrealistic ideal of one's body shape leads many to judge themselves as unattractive and lowers their self-esteem.

Body dysmorphic disorder is a preoccupation with an imagined defect in one or more of one's body parts, which causes considerable personal and social distress and occupational impairment. Some men tend to be concerned with their muscularity (*muscle dysmorphia*, or "bigorexia") and height, genitals, and thinning hair. Females tend to be concerned about their body size, buttocks, breasts, thighs, facial features, and body hair. The preoccupation with imagined physical defects leads to seeking medical procedures such as cosmetic ("aesthetic") surgery, cosmetic dentistry, or cosmetic dermatology (skin abrasions, Botox). Males may engage in extreme body-building activities, excessive consumption of ineffectual sports supplements, abnormal eating patterns, and ingestion of various illegal drugs. Females are at high risk for anorexia nervosa (see the following section). Almost always, efforts to change the identified defect do not produce mind-body harmony. Cognitive behavioral therapy and certain medications can help individuals reduce their preoccupation with their imagined

defects and help them establish a more realistic attitude about their bodies.

For the most part, standards of attractiveness and a healthful appearance are set by companies seeking to sell products and increase profits. Advertisements try to convince women that they fall short of an ideal and that by purchasing a product, dieting, or exercising to change their body size and shape, they can improve themselves and their lives. These messages cause many women to judge themselves on how they look and cause many men to judge women largely by their physical appearance. Overconcern about body image and weight can have adverse health consequences, including the following:

- depression from low body esteem and low self-worth,
- poor nutrition from extensive dieting,
- inadequate calcium and iron intake from undernutrition,
- anorexia or bulimia,
- musculoskeletal injuries from overexercising,
- risks associated with cosmetic surgery, and
- cigarette smoking to reduce body weight.

Eating Disorders

Eating disorders are complex psychophysiological conditions that manifest as compulsive, unusual eating behavior. Three of the most common eating disorders are *anorexia nervosa*, a voluntary refusal to eat; *bulimia*, binge eating and immediate purging of the ingested food either by vomiting or by using laxatives or intense exercise; and *binge eating disorder*, episodes of binge eating without subsequent purging. Occasionally, anorexia involves purging as well. The lifetime prevalence of eating disorders among American adults is approximately 5%. About 90% of those affected with anorexia nervosa or bulimia are women; nearly half of those with binge eating disorder are men. Eating disorders are anchored in tightly held, biologically inaccurate, and perfectionistic core beliefs, such as “You can never be too thin,” “Any fat is bad,” “I’m too fat,” and “Anything I eat immediately turns to fat that everyone else can see.” Striving to adhere to these core beliefs fosters compulsive disordered eating and purging behaviors (e.g., excessive exercise). In some instances, individuals hold so tightly to these beliefs and their associated behaviors that they reject any suggestions that they are at risk and must change or face serious health consequences and even death.

Compared to the general population, eating disorders are more prevalent among athletes, particularly among those whose bodies are exposed to view (swimmers, runners, gymnasts, dancers) or those whose performance may be affected by body weight (wrestlers, swimmers, divers, gymnasts, jockeys, and crew members) (Joy, Kussman, & Nattiv, 2016). Among athletes, attitudes and behaviors to lessen body weight, such as overexercising, dieting, or using drugs to lessen weight, are often considered normal and are even valued. Unfortunately, “thinner is better” activities rob the body of strength and energy, so they lead to decreased performance and occasionally illness. Also, acceptance of disturbed eating behaviors, overexercising, and compulsive attempts at

perfecting performance can attract people to certain sports who are vulnerable to developing an eating disorder. Women athletes who expend many more calories than they consume risk developing the **female athlete triad**: (1) cessation of menstruation (*amenorrhea*), (2) disordered eating, and (3) weak bones from osteoporosis. Athletes also are at risk for *orthorexia*, a rigid fixation with righteous and healthy eating. Orthorexia is associated with planning, buying, and preparing “proper” meals and guilt, anxiety, and self-punishment through excessive exercise for not doing so. Orthorexia is also associated with feeling safe from diseases and superior to others for one’s total commitment to the eating regime.

People with eating disorders are best helped by an interprofessional team that includes a primary care doctor, a personal therapist or psychiatrist, an eating disorder specialist, a dietitian, and school personnel. If appropriate, family counseling can be involved.

Anorexia Nervosa

Anorexia nervosa is characterized by a relentless pursuit of thinness that results in progressive weight loss and metabolic disturbances. Most of those affected are young women. Anorexia is not caused by any known disease-causing agent but by self-induced starvation, which can lead to serious illness and even death.

Elizabeth Barrett Browning (1806–1861), one of England’s most famed poets, is thought to have had anorexia nervosa. As a teenager, Elizabeth was nagged by her parents to eat and gain weight, yet she stubbornly refused to eat much more than toast. When she met her future husband, poet Robert Browning, she weighed only 87 pounds. Apparently, the Barrett family possessed characteristics found in other families with an anorectic member: overprotectiveness, overinvolvement with each other, and an inability to express or resolve intrafamilial conflict.

Persons with anorexia nervosa are likely to defend their emaciated appearance as normal and will insist that weight gain makes them feel fat. Besides distortions in normal body image, people with

anorexia nervosa tend to be preoccupied with food. They may spend an inordinate amount of time planning and preparing elaborate meals for others, while they themselves eat only a few bites and claim to be full. Often they will not eat in the presence of others; when they do, they may dawdle over their food. Some anorectic persons resort to self-induced vomiting or frequent use of diuretics or laxatives to reduce their body weight. These practices may lead to severe depletion of body minerals, which can precipitate abnormal heart rhythms and even cardiac arrest. Despite the low intake of calories, anorectic persons are remarkably energetic.



Eating Disorders Are a Worldwide Concern

The World Health Organization estimates that 70 million people in the world, both women and men, have a diagnosable eating disorder (Patel, 2005). Once common in North America and Europe, anorexia nervosa, bulimia nervosa, and binge eating disorder are not prevalent throughout the world (Galmiche, Déchelotte, Lambert, & Tavoracci, 2018).

Researchers say that a major cause of eating disorders is trying to emulate advertising models and actors that they see in American and European media and on the Internet. These media present images of “ideal” women and men as unrealistically thin, which causes some to lose social and psychological confidence in themselves; they attempt to regain it by disordered eating behaviors. For example, after the introduction of TV to the island of Fiji in 1995, the number of teenage girls with eating disorders rose from 3% to 15%. At the time, Fiji had only one TV station, which broadcast shows from the United States, Australia, and the United Kingdom. Whereas the increase might be attributable to something other than TV, researchers believe that the dramatic jump in the prevalence of eating disorders after the introduction of American and European images on TV is the most plausible explanation.

In Argentina, aggressive advertising by the diet and cosmetic industries was generally recognized as contributing to an epidemic of eating disorders. Major newspapers distributed discount coupons for diet and liposuction clinics. And Argentine clothing manufacturers—out of step with international standards—sized women’s clothes much too small (e.g., a “medium” T-shirt that is more suitable for a preadolescent than an adult), reinforcing the idea that a woman must be extremely thin to be socially desirable. The Argentine government and health establishment instituted a large media campaign of their own to educate young women on the dangers of believing what they see on TV, in the movies, and in magazines with respect to eating, body size, and cosmetic surgery.

Persons with anorexia may see themselves as responding to demands of others rather than taking initiative in life. Young people with anorexia tend to be obedient, dutiful, helpful, and excellent students. Some psychologists interpret the intense preoccupation with weight loss as an expression of an underlying fear of incompetence. Control of eating and body weight becomes a way of demonstrating general control and competence.

That anorexia nervosa affects predominantly young women suggests that its roots lie in our society's preoccupation with slimness as a prerequisite to social success. Anorexia may also reflect an attempt to remain a child who is cared for and fed by others, who can be stubborn and obstinate, and who has no sexual identity or desires. Anorexia may also be a manifestation of a struggle for a sense of identity and personal effectiveness through controlling the environment; the resulting stubborn, rejecting behavior then becomes reinforced by the attention received from others. The family of the anorectic person becomes so engrossed with the symptoms that they avoid dealing with conflicts among themselves.

Three goals characterize the treatment of anorexia nervosa: (1) weight gain, (2) changed attitudes toward food and eating, and (3) resolution of underlying personal and family conflicts. Unfortunately, therapeutic intervention is not always successful and the condition may persist for years. Anorexia nervosa has a 15% to 20% mortality rate.

Bulimia

Bulimia is marked by a voluntary restriction of food intake followed by a binge–purge cycle: extreme overeating, usually of high-calorie junk foods, immediately followed by self-induced vomiting, use of diuretics or laxatives, or intense exercise. Like anorexia nervosa, bulimia occurs primarily in young women with a morbid fear of becoming fat, who pursue thinness relentlessly. Most bulimic persons are model individuals: good students, athletes, extremely sociable, and pleasant. Fearing discovery of their bulimic behavior,

they frequently carry out their binge–purge episodes in private. Bulimic persons usually are aware that their binge–purge behavior is abnormal; however, they are unable to control it. Many feel guilty and depressed about their problem, which leads to a tendency to hide the behavior. Bulimia can pose a serious risk to health for many of the same reasons that anorexia does.

Several theories have been proposed to explain bulimia. One is that bulimia is a maladaptive way of dealing with anxiety, loneliness, and anger. Another suggests that bulimia is a manifestation of the drive to become the “ideal” woman, achieving the societal norm of slimness. Bulimic persons tend to have low self-esteem and a weak sense of identity.

Recovering from bulimia involves stopping binge–purge cycles and regaining control over eating behavior. Persons with bulimia must also establish more appropriate ways to handle unpleasant feelings and discomfort with close relationships, and their self-esteem must be improved. Cognitive behavioral therapy is considered the most effective psychological treatment for bulimia (Agras, 2019). Occasionally medications also are helpful.

Binge Eating Disorder

Binge eating disorder is characterized by an uncontrolled consumption of large quantities of food in a short period of time, even if the person does not feel hungry. During binge episodes, food is consumed much faster than usual, and frequently the person is alone to avoid embarrassment about the amount of food consumed. A binge episode is often followed by feelings of disgust, depression, and guilt.

About 2% of adults in the United States (about 4 million people) have binge eating disorder, and most of them are overweight. About 10% to 15% of people who are mildly obese and who try to lose weight on their own or through commercial weight-loss programs have binge eating disorder. The disorder is even more common in people who are extremely overweight.

Many people with binge eating disorder have a history of depression and impulsive behavior (acting quickly without thinking). Many people who are binge eaters say that being angry, sad, bored, or worried can cause them to binge eat. People with binge eating disorder tend to be malnourished because they consume large amounts of fat and sugar, which have few essential nutrients.

Most people with binge eating disorder have tried to control it on their own but are unable to control it for long. People with binge eating disorder should get help from a health professional, which could include instruction in how to keep track of and change unhealthy eating behaviors, identifying social factors that contribute to the problem, psychological counseling, and medications.

Critical Thinking About Health

1. Jordana couldn't stand herself anymore, so she went to the campus health center's peer nutrition counseling program for help.

"I disgust myself," she told her counselor. "I'm fat, fat, fat and no matter what I do I can't change it. I jog, I don't eat ice cream. I suck."

Jordana's BMI calculated out to 28.4. "It's a little on the high side," said the counselor, "but you're not in the danger zone."

"Tell that to my Dad," Jordana snapped. "And my boyfriend. When they look at me, their eyes go right to my stomach. It's like that's all I am—a stomach on legs!"

- a. What expectations regarding body size and shape do you experience as a member of your sex?
 - b. How were these expectations transmitted to you and by whom (or by what social institution)?
 - c. How are these expectations enforced in your peer group, and what are the social penalties for not meeting such expectations?
 - d. To what lengths do people go to meet these expectations? Are any of these practices extreme or unhealthy?
2. Sam: Oh, man, not Roni. She's too wide!

Mick: No, she's not. She's real nice. Call her.

Sam: Nah.

Mick: You're a loser, man. You didn't like Nan because her face was too round. You didn't like Carla because she was too tall. You didn't like Evy because . . . why didn't you like Evy, anyway? I forget.

Sam: Thunder thighs.

Mick: You're going to wind up one lonely dude.

- a. Is Sam really destined to be lonely or is he being smart to wait for someone who matches his ideal of the perfect body?

- b. In your peer group, are there examples of people being attracted to people who do not resemble the ideal? Can you explain that discrepancy?
 - c. What is the social purpose of an ideal body size and shape?
3. It is likely that in the near future there will be many drugs that are moderately effective in producing weight (fat) loss. It is also likely that these drugs will carry some risks to health.
- a. Do you think that such drugs should be made available to anyone who wants them, or should such medications be restricted to people whose weight puts them at serious risk for health problems and premature death?
 - b. Besides potential harm from side effects, is it appropriate for people to depend on drugs for weight maintenance instead of modifying dietary and exercise habits and learning to reduce stress?
4. How have eating disorders touched your life?

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Our ancient ancestors were physically active, having to spend most of their time and energy finding enough food to feed themselves and their families. In the past, most people were lean, often because they did not have enough food. Over thousands of years, plants and animals became domesticated, people clustered in towns and cities, and food became plentiful. The industrial revolution meant that machines began to do most of the hard work. People had leisure time and became less active physically. Today, in a computer–TV–smartphone world, people live largely sedentary lives both at home and at work. Hardly anyone in America walks to school or work anymore. Thus, approximately 68% of the American population is overweight. People who are overweight and who do not exercise regularly are at higher risk for heart disease, diabetes, and cancer than people who are lean and fit. As with all aspects of personal health, you are the one responsible for the quality and quantity of food you consume and the amount of exercise you get daily.

Weight-loss programs, drugs, and expensive advice are a multibillion-dollar industry. None produce long-term weight loss or fitness. Maintaining a healthy weight is simply a matter of energy consumed versus energy used day after day after day. Body energy is measured in units called *calories*, and these values are listed on all packaged and processed foods. The body's energy needs depend on height, weight, age, and degree of daily activity. Consuming fewer calories and using more calories in movement and exercise is the guaranteed method of weight loss. People who are overweight when young are usually overweight throughout life. The time to get your weight under control is when you are young and can exercise more vigorously than when you are older. To feel what your body endures when you are overweight, hold a 30- to 40-pound backpack in front of you and walk around with it all day. You *can*

choose to be of a healthy weight. The time to start eating healthy and being physically active is now.

HIGHLIGHTS

- Approximately two-thirds of the U.S. population is overweight and at risk for a variety of illnesses, including heart disease, type 2 diabetes, hypertension, and gallbladder disease.
- Obesity is defined as having a body weight 20% (for men) and 30% (for women) over recommended weight for height or a body mass index greater than 30.
- Health problems are less likely when the waist-to-hip ratio is less than 0.8 (women) or 0.95 (men).
- Body fatness is maintained by neural and hormonal signals acting on the brain, which controls feelings of hunger and satiety. Many physiological, psychological, social, and environmental factors affect the brain and thus body weight.
- People eat for reasons other than hunger such as social interaction, recreation, and relief from stress.
- Successful weight control involves changing eating and exercise habits.
- Healthy body weight corresponds to having a body mass index between 19 and 25. There are a variety of ways to achieve a healthy body weight. Starvation dieting is not one of them.
- Counseling, surgery, and medications can help some overweight people lose body fat and maintain a healthy body weight.

- There are three major ineffective weight-control schemes: body wraps, diet pills, and diet programs.
- Three common eating disorders are anorexia nervosa, bulimia, and binge eating disorder.

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KEY TERMS

essential fat:

necessary body fat required for normal physiological functioning

storage fat:

also called depot fat; energy stored as fat in various parts of the body

obesity:

storage fat exceeding 30% of body weight

body mass index (BMI):

a measure of body fatness, calculated by dividing body weight (in kilograms) by the square of height (in meters)

triglyceride:

a storage form of fat

homeostatic eating system:

integrated neurological and hormonal control of eating behavior based on the body's need for energy (calories)

hedonic eating system:

motivation to eat by the desire to experience a psychological reward, or pleasure from consuming food

palatable foods:

those which create the sensations of salty, fatty, and sweet

energy balance:

when energy consumed as food equals the energy expended in living

bariatric surgery:

weight loss surgery

liposuction:

surgery used to remove fat under the skin to reshape parts of the body

body image:

a person's mental image of his or her body

body dysmorphic disorder:

a preoccupation with an imagined defect in one or more of one's body parts

female athlete triad:

combination of disordered eating, cessation of menstruation (amenorrhea), and weakened bones (osteoporosis)

anorexia nervosa:

disorder occurring most commonly in adolescent females, characterized by abnormal body image, fear of obesity, and prolonged refusal to eat, sometimes resulting in death

bulimia:

serious disorder, especially common in adolescents and young women, marked by excessive eating, often followed by self-induced vomiting, purging, or fasting

binge eating disorder:

an uncontrolled consumption of large quantities of food in a short period of time, even if the person does not feel hungry



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CHAPTER 7

Movement and Physical Activity for Health



Health Tips

Incorporate Movement into Your Daily Activities

Weight Training Dos and Don'ts

Walking in Balance

Preventing Sports Injuries

Healthy Hydration



Dollars & Health Sense

Caveat Emptor: The Business of Sports Supplements



Wellness Guide

Financial Incentives to Get Healthy

Self-Care Exercise: The Body Scan

Getting into Shape

First Aid for Sports Injuries: RICE

LEARNING OBJECTIVES

1. List reasons that individuals get too little movement and physical activity.
2. Describe the four categories of physical activity: household tasks, work-related movement, leisure time activities, and performance-based activities.
3. Explain three different measurements of physical activity: calories per minute, METs, and PAL.
4. Describe levels of physical activity for health.
5. Explain the six components of physical activity: motivation, cardiorespiratory fitness, body strength, endurance, flexibility, and body composition.
6. Describe guidelines for integrating physical activity into one's life.
7. Discuss the types of performance-enhancing substances.
8. Define *overuse injuries*.
9. Discuss exercising in hot and cold weather.
10. Explain sports-related concussions.

Modern society depends on a vast array of machines (and the computers and “intelligent” software that control them) to carry out efficiently numerous industrial, personal, household, and economic processes.

Although it has freed people from considerable physical labor, the integration of work-saving machines into the fabric of modern life has had the inadvertent consequence of increasing risks to health from too little movement. Sedentariness and inadequate amounts of physical activity increase the risk of heart disease, overweight, type 2 diabetes, high blood pressure, osteoporosis, some forms of cancer, and premature death (U.S. Centers for Disease Control and Prevention, 2021). About 50% of U.S. adults, including college students, risk their health by being physically inactive; 60% of adults worldwide likewise put their health at risk. Studies show that humans do best when they expend about 1,000 calories a week in movement activities of any kind, including those involved in working, carrying out the tasks of daily living, and recreation (Simon, 2015).

A physically inactive lifestyle is a new dimension in human history. For 99% of the many thousands of years that humans have inhabited the earth, adults have had to walk, run, lift, bend, and carry in order to find and raise their own food, provide themselves with shelter, raise children, and protect themselves. However, starting about 200 years ago and accelerating greatly in the twentieth century, people began using machines to carry out all manner of activities ([Table 7.1](#)). Now, most of the North American labor force works in occupations that involve sitting at a desk, standing behind a counter, or occasionally walking a few steps while tending to others’ needs and requests.

TABLE 7.1 Twentieth-Century Innovations That Contribute to Reduced Physical Activity	
Year	Innovation

Year	Innovation
1900	Modern escalator invented
1901	Vacuum cleaner invented
1903	Airplane invented by the Wright brothers
1904	Tractor invented
1906	First Mack trucks built
1908	Ford begins to mass produce and sell Model T automobile
1923	Frozen food invented
1923	Television invented
1950	First automatic elevators
1951	First computers sold commercially
1954	First McDonald's
1956	Establishment of U.S. Interstate Highway System
1976	Apple home computer invented
1981	First IBM PC sold
1990	World Wide Web and Internet protocol and language created

Data from Transportation Research Board, Institute of Medicine. (2005). *Does the built environment influence physical activity?* Washington, DC: National Academy of Sciences.

Regardless of the type of work, a vast majority of Americans travel to their jobs while sitting in a vehicle. Furthermore, when they get home, even if they have few household tasks to do, many people watch TV, play video games, or interact with the Internet and social media rather than move their bodies (other than to go to the refrigerator). People living in modern, industrialized societies are

thought to expend almost half as much energy each day carrying out the tasks of living as ancient humans did (Booth, Chakravarthy, & Spangenburg, 2002).

About half of American adults spend a large percentage of their waking hours in **sedentary behavior** (from the Latin *sedere*, meaning “to sit”), such as sitting at a desk several hours a day (**Figure 7.1**). Sedentary behavior is characterized by little energy expenditure over that needed to stay alive, even less than to fuel a brief walk every day. Independent of the amount of physical activity, sedentary behavior increases the risk of overweight, poor health, and mortality (Lavie, Ozemek, Carbone, Katzmarzyk, & Blair, 2019). Engaging in an hour of moderate physical activity (e.g., walking) for every 8 hours of sitting can offset much of the health risk associated with many hours of sedentary behavior (Ekelund et al., 2016).

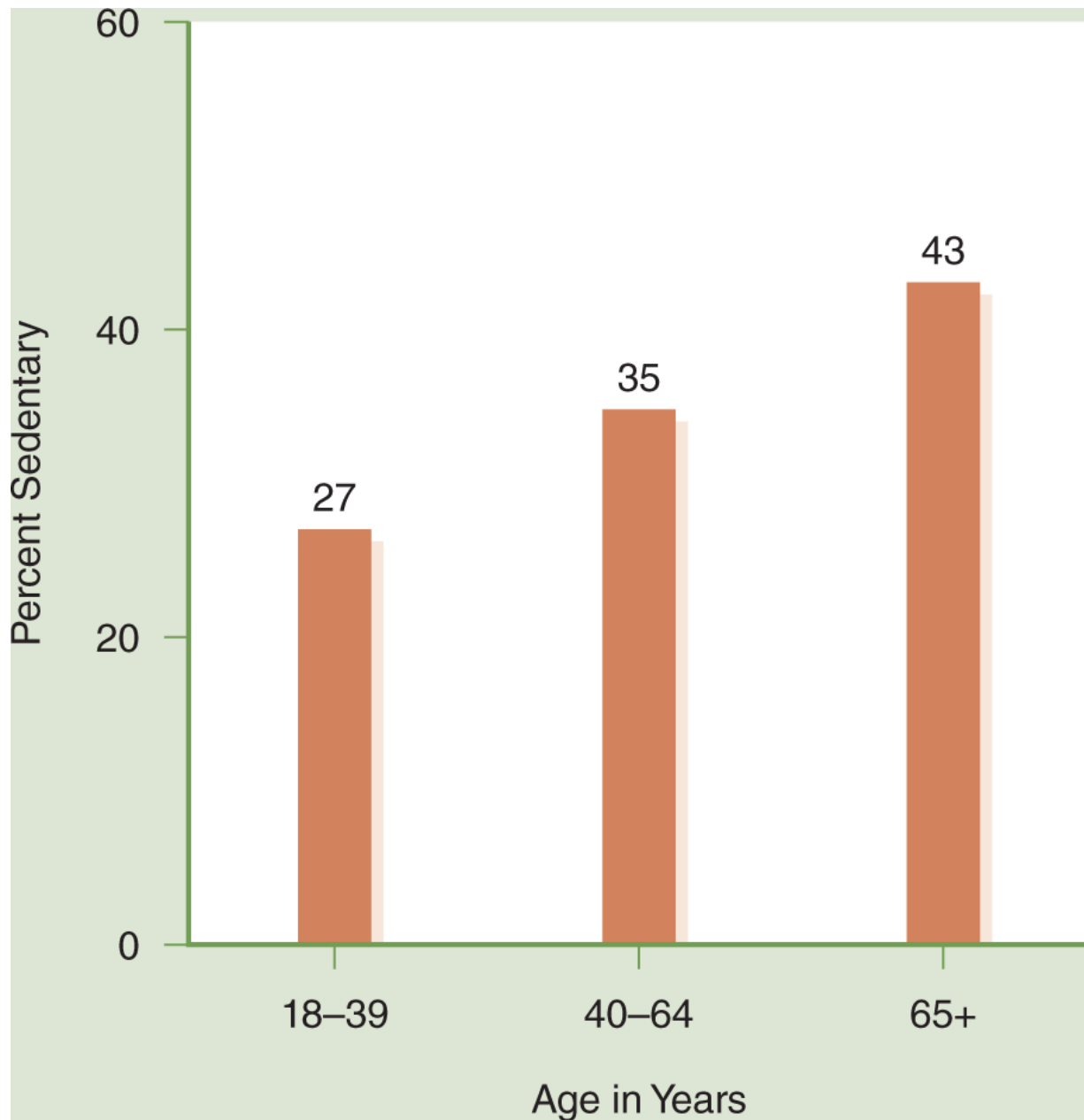


Figure 7.1 Sedentary Behavior Among American Adults by Age. Sedentary behavior was measured as sitting time, defined as daily time spent “sitting at work, at home, getting to and from places, or with friends, including time spent sitting at a desk, traveling in a car or bus, reading, playing cards, watching television, or using a computer” and was assessed with the question “How much time do you usually spend sitting on a typical day?”

Data from Ussery, E.N. (2018). Joint prevalence of sitting time and leisure-time physical activity among US adults, 2015-2016. *Journal of the American Medical Association*, 320, 2036-2038

Description

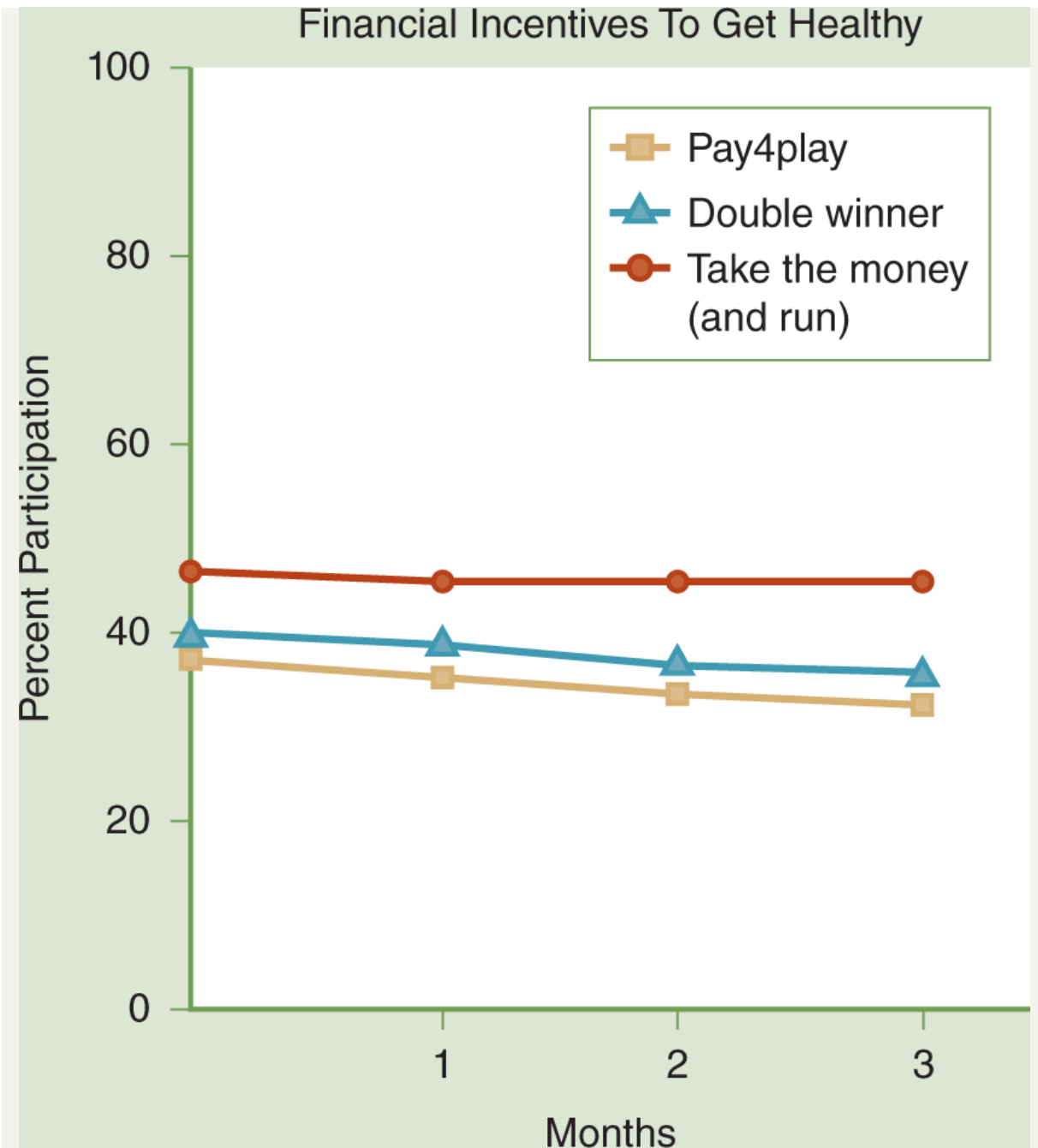


Financial Incentives to Get Healthy

Imagine the following scenario. Your employer wants the staff to be healthier by becoming more physically active, so the company is going to pay employees to walk 7,000 steps a day. Steps are counted via a smartphone app, and the total number of steps is transmitted to the program's exercise central database for recording. Participants receive \$25 to enroll. In their monthly paychecks, they receive \$20 for each month of participation in the program and any earnings from walking. Your employer is offering three incentive options. Which option would you choose?

Behavioral economists and health professionals are experimenting with ways to incentivize health behavior changes. The fictitious program described here is derived from an actual experiment of similar design conducted by researchers at the University of Pennsylvania Perelman School of Medicine (Patel et al., 2016). The results are depicted in the accompanying graph. From the data in the graph, which incentive is the most powerful? Was that the one you chose? Can you explain the results?

Pay4play	Double Winner	Take the Money (and Run)
Receive \$2 for each day you walk 7,000 steps.	Receive a lottery number between 00 and 99 on each day you walk 7,000 steps. One winning number is drawn each day. You receive \$5 for a one-digit match and \$50 for a two-digit match (and a bump in your health for walking even if you don't win any money).	Receive a \$60 credit at the first of each month. Deduct \$2 a day for each day you do not meet the 7,000-step requirement.



Financial Incentives to Get Healthy.
Description

Recognizing that physical inactivity is detrimental to health, many countries, communities, health professionals, public health

organizations, schools, employers, and religious organizations are seeking ways to encourage people to be more physically active, as the following illustrate:

- The U.S government, the European Union, the World Health Organization, and other governmental bodies have made engaging in physical activity national goals and are developing programs that encourage individuals to devote 30 minutes a day to some sort of movement activity.
- Employees receive company supplied training and time at work to engage in various types of physical activities.
- New housing developments are required to include inviting public spaces, parks, walking and biking paths and ensuring close access to public transportation and shopping to minimize driving.
- Walking during work hours is encouraged by placing parking lots some distance from buildings, giving employees pedometers or fitness apps, resetting elevators to run slowly to encourage walking stairs, and making staircases wide, carpeted, brightly painted, and with music and picture windows.
- Communities designate and maintain “safe walking” routes for schoolchildren and adult walkers.
- Colleges, universities, churches, and other organizations offer programs that encourage walking and other types of physical activity.

The Definition of Physical Activity

Physical activity is anything you do when you are not sitting or lying down, from clicking your computer's mouse to running a marathon. Among Americans and residents of developed countries, physical activity occurs in the following contexts (**Table 7.2**):

TABLE 7.2 | Comparison of Energy Used in Various Physical Activities

Context	Moderate Intensity (4–7 Calories/Minute, 3–6 METs)	Vigorous Intensity (7+ Calories/Minute, 6+ METs)
Household	Gardening Scrubbing a floor Carrying a child	Shoveling snow Pushing a lawn mower Active play with a child
Work	Sawing with a power saw Waiting tables Packing boxes for shipping	Hand sawing hard woods Firefighting Loading or unloading a truck
Leisure	Walking 3–4 miles per hour Yoga Dancing (most kinds)	Jogging or running Circuit weight training Tennis (singles)
Performance	Weight training Shooting baskets Skateboarding	Circuit weight training Football practice Long-distance running

Note: METs = metabolic equivalents

Data from *General Physical Activities Defined by Level of Intensity* (2010). U.S. Centers for Disease Control and Prevention. Retrieved from http://www.cdc.gov/nccdphp/dnpa/physical/pdf/PA_Intensity_table_2_1.pdf.

- *Doing household tasks* such as washing the floor, being with and taking care of children, and gardening.
- *Work-related movement* such as walking from a desk to the elevator, being a server in a restaurant, or working in construction.
- *Leisure time activities* such as taking a walk or engaging in recreational exercise such as dancing, running, swimming, or tennis.
- *Skill-based performance activities* such as exercising the body (or specific body regions) in order to excel at a particular activity or sport

Physical activity is scientifically defined in terms of the amount of energy expended to produce movement. Movement occurs when energy derived from food is utilized by muscles that are connected to bones to shorten (*concentric contraction*) or lengthen (*eccentric contraction*). When muscles shorten or lengthen, the bones they are attached to move, and so do you (**Figure 7.2**).

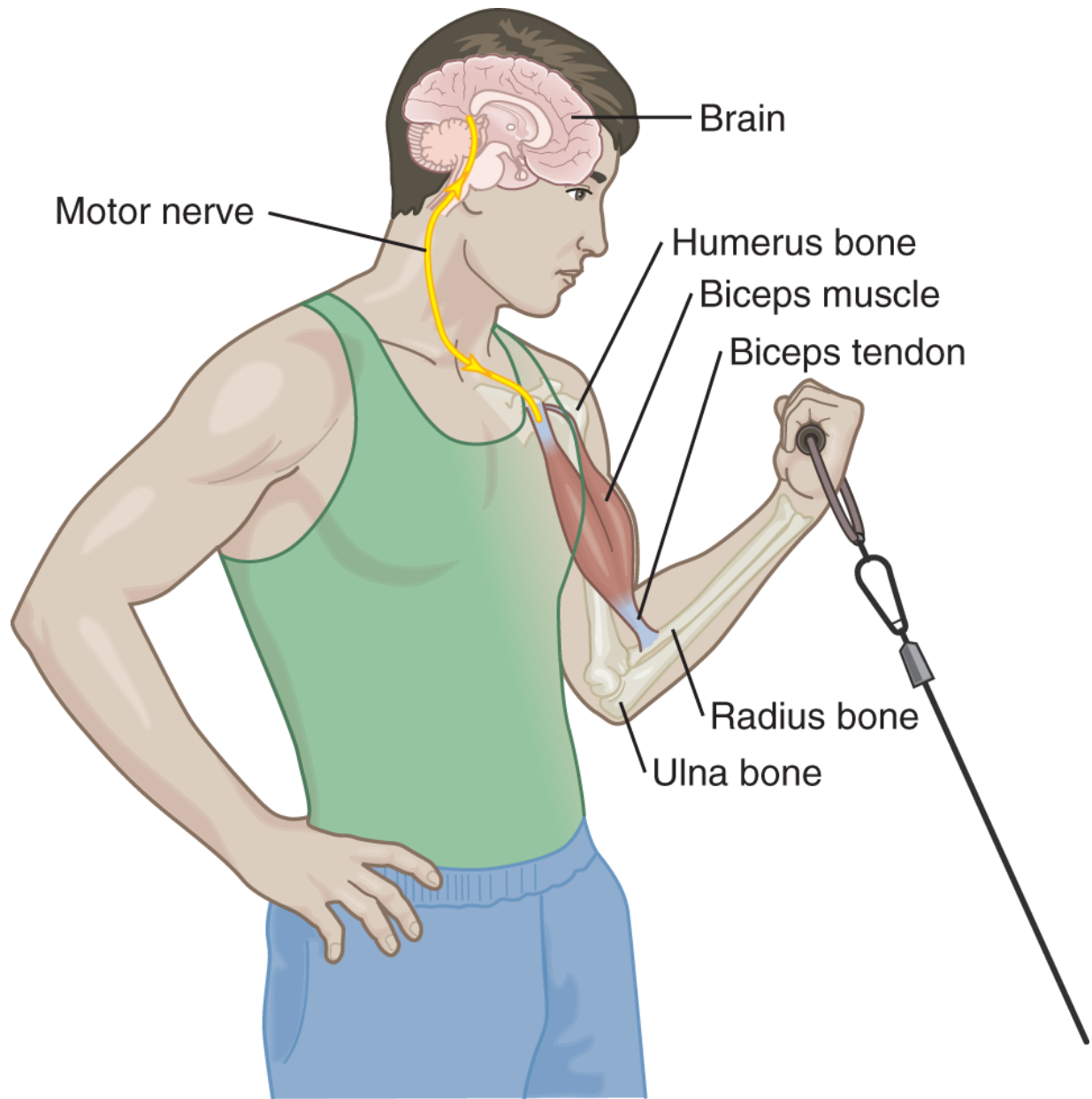


Figure 7.2 The Human Movement System. The human movement system consists of muscles, bones, tendons (which attach muscles to bones), and ligaments (which attach bones to bones). Movement occurs when the brain sends a signal via a specific nerve connecting it to a specific muscle. If the nerve signal directs a muscle to shorten, the two bones it connects move toward each other. If the nerve signal directs the muscle to lengthen, the two bones it connects move away from each other.

Description

Energy for movement is derived principally from carbohydrate and fat—and on occasion the amino acids in protein, but not vitamins and minerals—which the body acquires from food and can store until needed. There are 4 calories of energy in a gram of carbohydrate and protein, and 9 calories of energy in a gram of fat. Energy can be derived from food with or without the addition of oxygen. Oxygen absent energy production is called **anaerobic**; oxygen present energy production is called **aerobic**. Compared with oxygen absent, oxygen present energy production is nearly 20 times more efficient, which is the major reason you breathe.

A man is never so happy as when his mind, his senses, and his heart are all working harmoniously together.

—**Seneca**, Roman philosopher

Oxidation is the chemical term for the process of oxygen present energy production. *Burning* is another term for the process of oxidation. When biological material is burned in a fire, oxidation generates little useful energy and considerable heat. When carbohydrate and fat are burned in cells, oxidation is controlled to capture the energy for useful work and to minimize energy lost as heat. So when you hear the expression “burn calories,” it means extracting energy to fuel cellular processes and not melting fat with heat.

The nervous system controls movement by signaling muscles to contract. Some movements are *reflexive*, meaning they do not require a conscious decision—for example, when quickly pulling your hand from a hot stove. A *voluntary movement*, like kicking a ball, involves both decision and movement control centers in the brain, which send nerve signals to specific muscles, resulting in movement.

Physical activity is measured in terms of calories used per minute, metabolic equivalents, or physical activity level, as follows:

- *Calories used per minute:* A nutritional or movement calorie is scientifically defined as the energy equivalent of the amount of heat energy required to raise a kilogram of water from 15.5°C to 16.5°C. Muscles do not use heat as an energy source; energy is chemically extracted from carbohydrate and fat within muscle cells and provided directly to the tissue that creates movement. A calorie can fuel about 25 steps of walking. The calories utilized in various physical activities are presented in Table 7.2.
- *Metabolic equivalents (METs):* **Metabolic equivalents (METs)** are per minute multiples of the amount of energy used while sitting or lying still, which is defined as 1 MET. For people of average size, 1 MET is about 1.2 calories. Moderate physical activity utilizes 3 to 6 METs; vigorous physical activity utilizes more than 6 METs (see Table 7.2).



Tennis is an excellent form of exercise at any age.

© Nycshooter/iStock/Getty Images Plus/Getty Images



Incorporate Movement into Your Daily Activities

- At school or work, take movement breaks by walking or doing desk exercises instead of taking food breaks. If you are the social type, go with a friend on a talk walk.
- Exercise while watching TV (for example, use hand weights, a stationary bicycle, treadmill, or stair climber or stretch).

- *Physical activity level (PAL):* **Physical activity level (PAL)** is a measure of the amount of energy expended per day over and above that required for *basal* or *resting* metabolism, which is the

energy needed to fuel basic life functions (i.e., heartbeat, breathing, kidney and brain function, etc.). A person is considered sedentary if the PAL is less than 1.4—that is, the daily energy expended to fuel all forms of movement is less than 1.4 times the energy expended in basal metabolism. PAL values between 1.4 and 1.7 indicate a moderate level of physical activity. PALs greater than 1.7 indicate a vigorous level of physical activity (**Figure 7.3**).

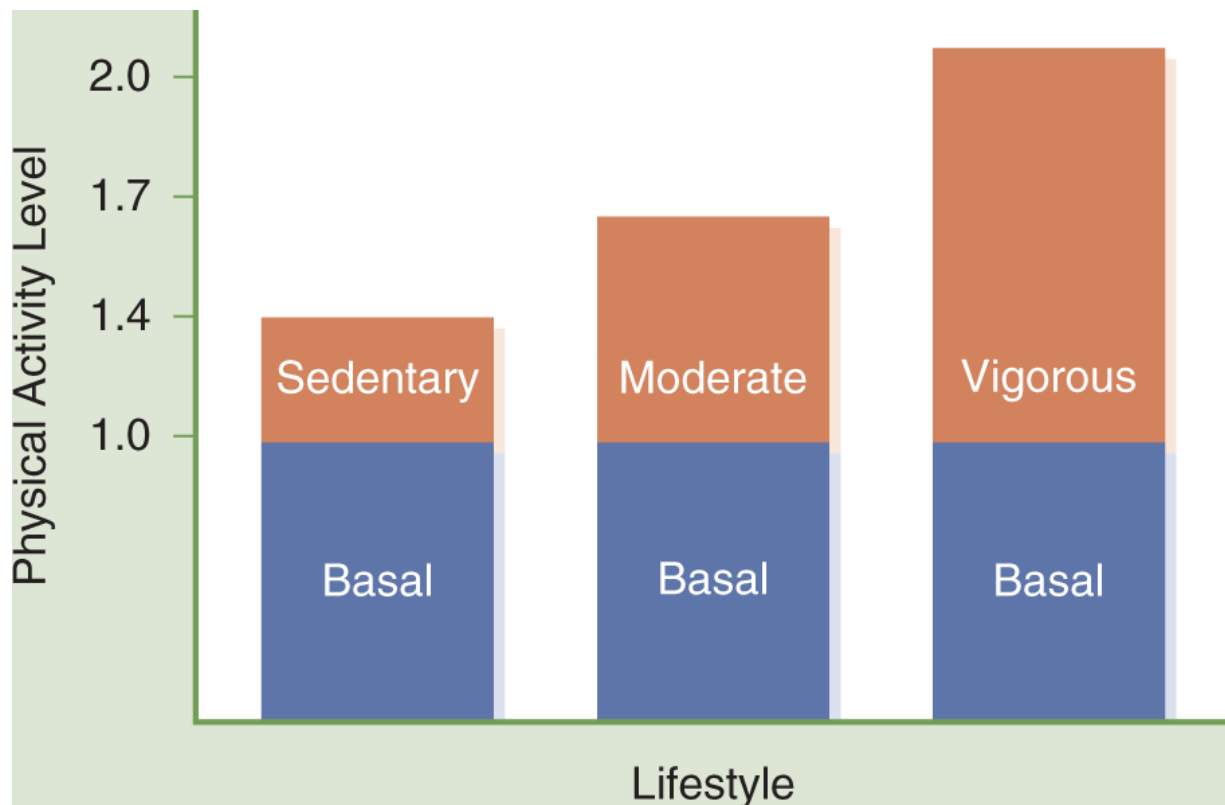


Figure 7.3 Physical Activity Levels. Physical activity level (PAL) is the amount of daily energy expended over and above a person's basal or resting metabolism, which is the energy required to fuel basic life functions while at rest.

Description

Any movement or activity can be discussed in terms of the following FITT dimensions:

- *frequency*—how often the movement or activity occurs,
- *intensity*—the energy required to render the movement or activity,
- *time*—how long the movement or activity takes place, and
- *type or mode*—the kind of movement or activity.

For example, you can walk (*type*) for 10 minutes (*time*) to a particular class three times a week (*frequency*) at a pace utilizing 4 calories per minute (*intensity*). Thus, each walk to class utilizes 40 calories of energy, with a resulting expenditure of about 120 calories per week (10 minutes × 4 calories per minute).

Physical Activity for Health

In the 1950s, a pioneering study on the relationship of movement and health found that 30% fewer conductors in London’s double-decker buses had heart disease compared to their coworkers who drove the buses. The reason: Conductors were more active than the drivers because they were continually moving between decks taking passengers’ tickets. Since that time, thousands of studies have confirmed that movement and physical activity are good for health, irrespective of smoking status, body weight, and other health-related characteristics.

Moderate amounts of regular physical activity—whether it is household, work related, leisure time, or performance enhancing—counteracts the deleterious effects of inactivity and sedentariness and contributes to health and well-being in a variety of ways ([Table 7.3](#)). A moderate amount of physical activity expends between 1.4 and 1.7 times the energy required for basal metabolism, which for most people amounts to 120 and 300 calories per day of activity, or a total of about 600 to 1,500 calories per week (Figure 7.3).

TABLE 7.3 Health Benefits of Physical Activity	
	Puts into life the good feelings and enjoyment that come from body movement
	Increases the ability to cope effectively with stress
	Increases endurance in daily activities and lessens fatigue
	Increases longevity
	Strengthens the heart muscle
	Decreases the heart rate
	Increases blood flow to the heart

Maintains normal blood pressure and reduces high blood pressure
Increases blood levels of high-density lipoprotein (good) cholesterol
Reduces blood levels of low-density lipoprotein (bad) cholesterol
Reduces blood levels of triglycerides (fats)
Boosts the immune system, thus lessening the risk of colds and other infections
Enhances sleep
Maintains a healthy body weight
Improves food choices
Increases bone mass and reduces the risk of osteoporosis
Prevents and alleviates chronic low back pain
Lessens the desire to smoke cigarettes and consume alcohol and drugs
Lessens depression
Enhances self-image, self-esteem, and creativity

The scientifically based finding that *moderate* levels of physical activity are beneficial to health stands in stark contrast to the exhortations of the health club, exercise equipment, dietary supplement, and fashion industries, as well as the advertising, popular magazines, and infomercials that support them. These commercial interests would have people believe that movement for health requires considerable time, special equipment and clothing, excessive effort, and sweating a lot in order to attain a svelte, lean body (and for men one that is highly muscular or “cut”)—appearances more suited to computer-enhanced images than real people. You do not have to run like an Olympic athlete or look like a model in a fitness advertisement to be healthy.

An efficient way to attain a moderate level of physical activity is to walk briskly for 30 to 45 minutes on most days of the week (**Figure 7.4**). Your pace should be such that your heart and breathing rates increase slightly but not so much that you cannot carry on a conversation while walking; for most people, this pace is about 3 to 4 miles per hour. Also, you should experience a light to moderate increase in **relative perceived exertion**, which is awareness that you are responding to exercise (sensations of effort and muscular force, breathing rate, and body and skin temperature).

Park your car a 10-to-15-minute walk from your destination.

Walk or march in place when on your phone.

Walk or march in place during every TV commercial.

Use a table, desk or chair to do push-ups: Stand and place your hands on a table, a desk, or the back of chair and perform 10 push-ups.

Set phone timer: At your desk, move or stretch at least 3 to 4 minutes every hour.

Chair on fire: Sit on edge of chair; stand; sit and then stand immediately (chair on fire!); do 10 reps.

Walk during breaks and lunch. Don't eat and sit the entire time.

Hold walking meetings. Stand during presentations or webinars.

Take the stairs, not the elevator.

Take the longest walking route feasible to the restroom, even if you have to go to another floor.

Take the longest walking route to any source of food.

Do partial squats, knee, and calf raises while waiting to use office equipment such as copiers, microwaves, and fax machines.

Keep a resistance band to perform strengthening and stretching exercises at your desk or while watching TV.

Walk or jog in place for 2 minutes *whenever* you get up from your desk.

Desk dance. Move your feet, arms, and shoulders to favorites from your playlist.

Keep an exercise log to keep you focused.

Walk or talk with a buddy to keep it fun.

Listen to audiobooks to keep it interesting.

Walk a dog to be a pal.

Figure 7.4 Put a Little Movement in Your Life.

Data from University of California, Riverside MoveMore. go/ucr/edu.

Description

Although it seems tame in comparison to running on a treadmill, walking is nevertheless excellent for health (Kelly et al., 2014). It strengthens the heart and skeletal muscles, increases breathing ability, clears and quiets the mind, reduces stress, uses calories (weight maintenance), and causes few injuries, if any. Other than appropriate footwear, walking requires no special clothing or equipment and, with a little preplanning, can be worked into any busy schedule; you can break up the total walking time into several small parts and attain the same health benefits. Walk stairs instead of riding an elevator; park the car 10 minutes from your destination and walk the rest of the way; take a dog for a walk twice a day (Fido will be forever grateful); do a walk talk with a friend, family member,

or spouse (good for relationship maintenance and also fun); and make it a habit to walk or walk in place rather than sit while you talk on your mobile phone.

Many people find that counting their daily steps with a **pedometer**, accelerometer, or a fitness phone app, helps keep them focused on walking. An average-sized person takes 2,000 steps to walk a mile. Health experts recommend taking a total of 10,000 steps per day in all one's activities combined—15,000 if possible—and keeping a step-count diary that records not only the number of steps you take but also any obstacles that prevented you from walking as much as you wanted to.

People who enjoy vigorous physical activities (e.g., running, swimming, singles tennis) should do them at least 3 days a week for 20 minutes each time. Vigorous activities have PALs of between 1.7 and 2.5. They utilize 7 or more calories per minute, make you breathe hard and sweat, and are sufficiently intense that you cannot easily talk to anyone while doing them. Compared with moderate physical activity, vigorous physical activity provides slightly greater heart health benefits and longevity (Bouchard, Blair, & Katzmarzyk, 2015) (**Figure 7.5**). However, it also carries a higher risk of physical injury and psychological burnout, either of which can curtail activity for weeks or even months.

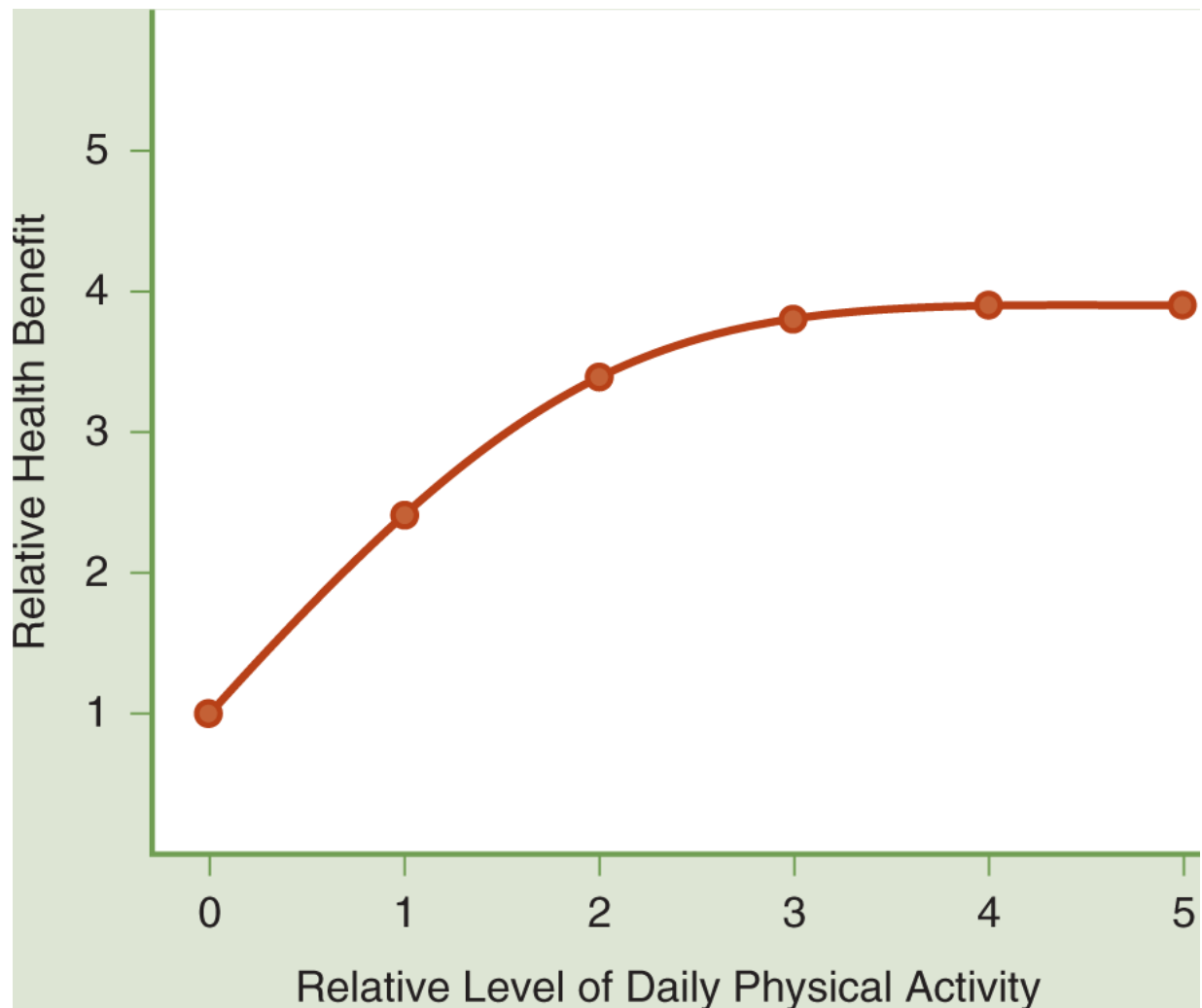


Figure 7.5 Relative Health Benefit of Physical Activity. The graph is a composite from many studies that demonstrate the positive effect of physical activity on health. Notice that the graph is not linear; the largest benefit comes from changing from no to little daily physical activity to low to moderate levels of physical activity. High levels of physical activity do not produce corresponding gains in health. Health benefits include lessened risk of morbidity and mortality from cardiovascular disease, cancer, hypertension, and type 2 diabetes. Each level of physical activity (e.g., walking, running, cycling) corresponds to between 500 and 1,000 calories per week of activity.

Data from Bouchard, C., et al. (2015). Less sitting, more physical activity, or higher fitness? Mayo Clinic Proceedings, 90, 1533–1540.

Description

Besides direct effects on health, both moderate and vigorous physical activity can provide time and attention for *you*. Many people feel overwhelmed by the demands of school, jobs, and family. Just taking a few minutes several days a week to move your body can give you a chance to relax, reflect, and indulge your imagination. Also, physical activity can reduce stress, anxiety, and depression; improve mental functioning; and contribute to enhanced work performance by inducing healthy changes in the brain (Autio, Stenbäck, Gagnon, Leppäluoto, & Herzig, 2020).

Psychological Benefits of Physical Activity and Movement

In addition to many physiological benefits, physical activity and movement can also enhance mental health. Studies have shown that moderate physical activity can reduce stress, anxiety, and depression; improve sleep and mental functioning; and contribute to enhanced work and academic performance (Chekroud et al., 2018). These outcomes are thought to be related to increases in metabolism, oxygenation, and blood flow in the brain; changes in neurotransmitters that are associated with alertness (norepinephrine), pleasure and reward (dopamine), euphoria, well-being, and decreased sensitivity to pain (endorphins, enkephalins, and endocannabinoids); and changes in growth factors affecting specific neurons in the brain. Physical activity can also promote the experience of relaxed concentration, regular breathing rhythms, and increased self-awareness, outcomes similar to meditation and yoga.

Another mental health benefit of physical activity comes from simply setting aside time on most days from life's other activities and responsibilities to devote yourself to something you enjoy.

Components of Physical Activity

Although your whole being responds to movement, it is possible to identify the following six components of physical activity:

1. *motivation*—the willingness to focus attention and energy on movement;
2. *cardiorespiratory fitness*—the body's ability to obtain and utilize fuel and oxygen efficiently during sustained, effortful physical activity;
3. *body strength*—the ability to lift or move an object (including your body, as when you walk or climb stairs);
4. *endurance*—the ability to move an object (including yourself) without becoming quickly fatigued;
5. *flexibility*—the ability to move a joint (where two bones meet) through its anatomical range of motion; and
6. *body composition*—the body's relative amounts of water, bone, fat, and tissue.

These six components and activities that promote them are discussed in the following subsections.

Motivation

Your ancient ancestors did not require specific motivation to be physically active. Because they had to move their bodies to acquire food and avoid environmental dangers, hunger and fear were motivation enough for movement. Most modern humans can eat and be safe without much daily movement; indeed, many occupations require little movement. Thus, to gain the health benefits from movement, other motivations must come into play, including the following:

- being paid, such as in an employer-sponsored exercise class;

- desiring to be healthy;
- desiring to “look good”;
- enjoying socializing while engaging in a movement activity; and
- accomplishing a personal goal such as losing weight, climbing a mountain, running a distance race, or biking 50 miles.

Regardless of the motivation, it is important that one’s chosen physical activities be enjoyable or at least not objectionable. Doing enjoyable activities promotes continuing with them. If what you do is unpleasant, however, you won’t do it for long. This might mean experimenting with several types of activities in order to find ones that you are likely to make a regular part of your life. It might mean engaging in more than one activity to break up monotony and boredom. **Cross-training** is incorporating more than one activity into your regular activity plan—for example, walking 4 days a week and doing strength training or cycling 2 days a week (and resting 1 day).

Also, it is important to realize that obstacles to accomplishing one’s movement goals arise frequently. Regardless of your motivation and dedication, there may be weeks or even months when getting your desired level of physical activity is a challenge. Perhaps you get sick or injured. Perhaps your schedule is tight and there seems to be no time for anything but work. Perhaps you lose interest in former activities. At such times it is important not to become so discouraged that you give up wanting physical activity in your life. Realize that obstacles are to be expected and that they will pass in time. When they do, you can resume your desired activities or replace them with better alternatives.



Self-Care Exercise: The Body Scan

Body scan is a mind shifter. It redirects awareness from thoughts and feelings to noticing what is going on in your body. Its benefits are to stop rumination, settle “monkey mind,” better sleep, being grounded, and being connected to Earth. While body scanning, if your mind wanders—*notice!*—take a deep breath or two and resume scanning. (Video instructions: <https://www.youtube.com/watch?v=ANZfVnjCmXk>)

- Comfortably sit or lie down; notice feet or back making contact with the floor; shoulders down from your ears; let hands go where they want to go; close your eyes if that's comfortable for you.
- Take at least three calming breaths—in for a 4 count, hold for 4, then out for 5. Let your body relax.
- Shift your attention to the toes on your left foot. Be curious about each one. How does each feel? Warm, cold, tingly, stiff, ouchy?
- Shift the focus of your awareness to your left ankle and calf. What sensations are there? Pressure, tightness, warmth, cold, heavy, lightness?
- Shift your attention to your left thigh. What do you notice?
- Repeat the scans above for the right leg.
- Bring your attention to your pelvis, hips, and lower back. Silently name what you notice: tightness, tingles, discomfort, relaxed?
- Bring your attention into your stomach area. Silently name what you notice.
- Notice your left upper arm, forearm, hand, and fingers. Note any sensations. Repeat for right arm.
- Focus your attention on your left shoulder. Note any sensations. “Breathe into” any tension. Repeat for your right shoulder.
- Notice sensations in your neck and throat. Let any tension melt into relaxation.
- Relax your jaw. Let your face and facial muscles be soft.
- Notice your whole body from toe to head. Take two calming breaths—again, in for a 4 count, hold for 4, then out for 5. Open your eyes when ready.

Cardiorespiratory Fitness

Cardiorespiratory fitness is the degree to which the body can supply sufficient fuel (carbohydrate, fatty acids, and oxygen) to produce sustained, effortful physical activity—in other words, the degree to which someone is “in shape.” Exercise physiologists define cardiorespiratory fitness in terms of the maximum amount of oxygen the body can utilize in physical activity, which is called VO_2 max (“volume of oxygen maximal”). Studies show that higher fitness levels, defined by VO_2 max, are associated with a lower risk of death from cardiovascular disease. It is not known how cardiorespiratory

fitness reduces the risk of heart disease; one suggestion is that it lowers blood levels of total and bad cholesterol and triglycerides, which are progenitors of heart disease. Cardiovascular fitness also lowers the heart rate.

Because modern lifestyles do not require vigorous physical activity in carrying out daily life tasks, attaining high levels of cardiorespiratory fitness requires planned bouts of sustained, high-intensity, vigorous activity called **aerobic training**, or what many people call “working out.”

Aerobic Training

Aero is derived from Greek, meaning “air.” With regard to physical activity,

- *Aerobic* means requiring oxygen.
- *Aerobic exercise* is any activity that requires the body to use more oxygen than it does in usual activities.
- *Aerobic capacity* is the extent to which an individual can perform aerobic exercise.
- *Aerobic training* is engaging in aerobic exercises *on a regular basis* to increase the amount of oxygen the body can process in a given time. Aerobic training requires that the heart and lungs work harder than usual to provide oxygen to exercising muscles. In this way, they become more efficient in acquiring and delivering oxygen to the body, both during exercise and at rest.

When aerobic training is carried out over a period of time, the resultant physiological changes in the heart, lungs, and muscles are called the **training effect**, or “in shape.” You induce the training effect by exercising such that the heart rate during exercise increases to between 60% and 80% of its theoretical maximum. This is called your **target heart rate**. To determine your target heart rate:

- Calculate your theoretical *maximum heart rate* (MHR) by subtracting your age from 220.
- Multiply your MHR by 60% and 80% to determine the lower and upper limits of your target heart rate, which is called the *target zone*, *target heart rate zone*, or “in the zone.”

For example, for a 20-year-old, the MHR is 200 ($220 - 20$), and the lower and upper limits of the target zone are 120 ($60\% \times 200$) and 160 ($80\% \times 200$) heartbeats per minute (see [Table 7.4](#)).

TABLE 7.4 Maximum and Target Heart Rates Predicted from Age

Take your pulse for 15 seconds immediately after exercising and multiply by 4. If your heart rate is in the target range for your age, optimal training benefits have been obtained. If below target range, step up activity. If above the maximum, take it easier during workouts and gradually increase intensity.

Age (in Years)	Predicted Maximum Heart Rate (in Beats per Minute)	Target Heart Rate Range (in Beats per Minute)
20	200	120–160
25	200	117–156
30	194	114–152
35	188	111–148
40	182	108–144
45	176	105–140
50	171	102–136
55	165	99–132

60	159	96–128
65	153	93–124

Exercise 3 to 4 days per week is sufficient to produce a training effect. Two days per week may suffice for people already in good condition. One day a week does little to improve fitness and may increase the risk of injury. Also, exercising more than 5 days a week does little to increase fitness. It does expend calories, but it also makes one susceptible to injuries.

A session of aerobic exercise should begin with about 10 minutes of warm-up activity during which the heart rate gradually increases (**Figure 7.6**). As the intensity of activity increases, the target zone heart rate is attained and maintained for 20 to 30 minutes. This is followed by a cool-down period during which the heart rate returns to pre-exercise levels. You can obtain your heart rate with a heart-rate monitor, a device you strap to your chest or wrist, or by counting your heartbeats at your wrist or carotid artery (**Figure 7.7**).

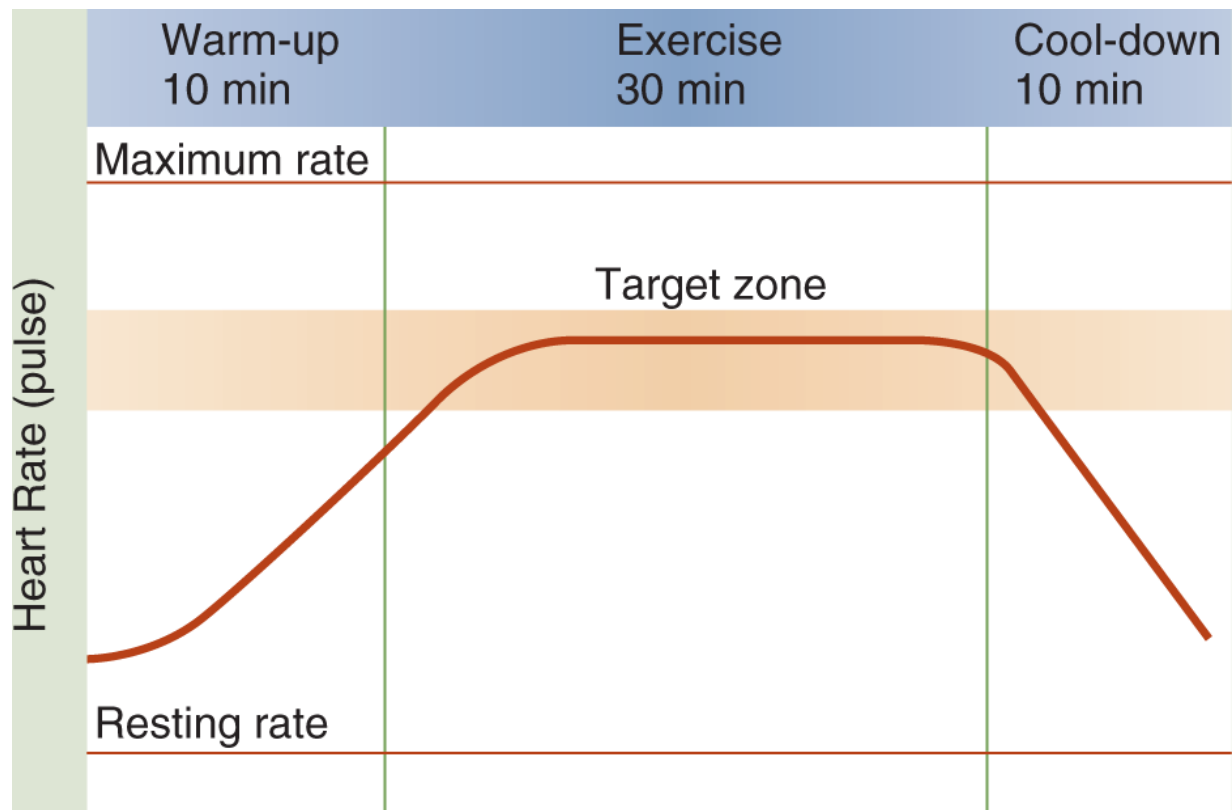


Figure 7.6 Heart-Rate Pattern for a Typical Exercise Routine. A diagram of heart rate during warm-up, aerobic exercise, and cool down.

Description



Figure 7.7 Measuring Your Heart Rate. Place your index and middle finger (not your thumb) on the opposite wrist an inch below the thumb or at the side of the throat (Adam's apple). Press until you feel the pulsations. Count the beats for 15 seconds. Multiply by 4 to get heart rate in beats per minute.

© Duncan Smith/Photodisc/Getty Images

Body Strength

Body strength is the ability of a muscle or group of muscles to move an object, including your body. Whereas it often conjures up images

of supermuscular body builders lifting heavy weights, body strength for health requires minimal, if any, change in body size and lifting of weights. The goal is to have sufficient strength to carry out normal tasks (work, lifting packages, walking stairs, shoveling snow) and participate in physical activities without injury. Two popular ways to increase body strength are strength training and Pilates.

Strength Training

Strength training (also called *resistance training*) involves building muscle and bone strength by repetitively moving individual muscles or muscle groups against resistance, commonly applied by weights such as barbells, dumbbells, and exercise machines and also by pushing against an immovable object (**isometric training**). Some of the benefits of strength training include the following:

- enhanced ability to combat fatigue in everyday activities,
- improved fitness,
- preventing and rehabilitating orthopedic (musculoskeletal) injuries,
- reduction in body fat,
- increased basal metabolic rate,
- decreased blood pressure,
- lower risk for cardiovascular disease, and
- lessen low back pain.

Many people imagine that the goal of strength training is to greatly enlarge the size of the body's muscles. This is an image proffered by the media (and advertising to sell dietary supplements and exercise machines) that idealizes a muscular body as a sign of attractiveness. Many men believe that a large, muscular body is the definition of masculinity. However, from a health point of view, the goal of strength training is stronger muscles, not necessarily bigger ones.

Strength training for health means having the strength to participate without hindrance in activities of daily living and the ability to move muscles over a period of time (endurance). Strength training to increase muscle size is a highly specialized activity: *body building*.

To engage in strength training for health and fitness, the American College of Sports Medicine recommends the following for healthy adults:

- Follow a specific activity plan (workout) two to three times a week.
- Perform 8 to 10 resistance exercises per workout.
- Exercise all major muscle groups.
- Repeat each exercise 8 to 12 times (“reps”).
- Use an amount of weight that can be moved the desired number of times.
- Breathe normally while exercising.
- Move a muscle or muscle group through the full range of motion.
- Warm up prior to and cool down after an exercise session.

Whereas gyms and health clubs can supply all manner of strength training equipment, one needs only a few 5- or 10-pound dumbbells and a simple training program to derive considerable health benefits from strength training.

Strength training can involve progressive increases in the time, intensity, and amount of weight moved. Muscle strength is built by moving heavy weights a few times per set, whereas endurance is built by moving smaller weights through many repetitions. Also, in an extended training program, the repetitions, number of sets, amount of weight, and other exercise variables should vary (called *periodization*). To avoid injury (see the Health Tip “Weight Training Dos and Don’ts”), it is imperative that one receive professional

assistance in the design of a strength-training program and professional instruction in strength-training methods.

Compared with most aerobic exercise, strength training produces only a modest improvement in cardiovascular fitness. The time spent exercising is insufficient to increase the heart rate long enough to produce a training effect. The energy expended during strength training is about 4 calories per minute, nearly the same as for walking or swimming at a comfortable pace.





The Pilates method strengthens core muscles.

© Lorena Natalia Fernandez/Getty Images



Weight Training Dos and Don'ts

Do

- Use spotters when trying major lifts.
- Keep your back straight when lifting.
- Use proper lifting technique.
- Wear shoes with good traction.
- Use equipment that is in good condition.
- Follow safety rules.

Don't

- Hyperventilate or hold your breath—breathe out when you press.
- Continue if you feel pain; ice the painful region.
- Lift if you feel lightheaded.
- Exercise a set of muscles more than three times per week.
- Cheat on technique to lift heavier weights.

A common myth associated with strength training is that consuming high protein foods and special vitamin supplements will increase muscle mass. This assumption is incorrect. Muscle tissue responds to the demands of work, not to food. In a progressive strength-training regimen, sufficient protein to build new muscle tissue will be obtained in a well-balanced diet. Excess protein and vitamins are simply excreted.

Pilates

Pilates is a widely used method of body conditioning developed by Joseph H. Pilates (pronounced Puh-LAH-tees) in the 1920s. The body-building and fitness regimen he developed became widely used all over the world by dancers, actors, sports teams, spas, and fitness enthusiasts.

The Pilates method consists of hundreds of stretching and strengthening exercises that are performed on a mat with or without Pilates rings and other devices used to assist in strengthening muscles. Many of the exercises are designed to strengthen the back, abdomen, and buttocks; Pilates believed that these regions were the core of strength and the basis of good posture. Like yoga, the Pilates method emphasizes a balance of mind, body, and spirit. Rather than performing many repetitions of exercises, Pilates advocated intense mental concentration on performing each exercise with precision and awareness. Although developed many years ago, the Pilates exercises are still widely used to improve strength and performance and for overall body conditioning.

We live too short and we die too long.

—**Walter Bortz**, MD, Professor of Medicine

Endurance

Endurance is the ability to move an object, including yourself, without becoming quickly fatigued. Endurance is a combination of

fitness, strength, and motivation. The fitness aspects of endurance relate to the body's ability to acquire and utilize oxygen, carbohydrate, and fat to fuel movement for an extended period of time. The strength aspect of endurance involves having sufficiently strong muscles to carry out an activity for an extended period without damage. The motivational aspect of endurance is the will to carry on with an activity even though you feel fatigued.

Endurance develops by extending yourself past former limits of physical activity. In this way, the anatomy and physiology of the heart, lungs, muscles, and energy-supplying and energy-utilizing systems, and your own expectations of your ability to persevere gradually adapt to meet the challenges of extended activity. Endurance training generally involves both aerobic and strength-training activities.

Flexibility

Flexibility is the degree to which you can rotate, bend, and twist a part of your body. Rotating, bending, and twisting occur where bones meet, an anatomical structure called a *joint*. For example, your elbow is a joint at which the two lower arm bones attach to the upper arm bone, allowing you to bend your arm. Imagine how difficult arm movement would be if you had no elbow joint.

Joints are held together by ligaments and tendons, which are elastic, fibrous bands of *connective tissue*. Flexibility is determined by the pliability of a joint's connective tissue and associated muscles. Every joint has a **range of motion**, which is the amount of rotating, bending, or twisting that the anatomy of the joint allows. Satisfactory flexibility is being able to move a joint through its full range of motion. Satisfactory flexibility contributes the following health benefits:

- Lessens the effort in carrying out physical tasks, such as lifting a package or bending to pick up something.
- Fosters good balance, which aids mobility and reduces the risk of falling.

- Reduces bodily and psychic tension resulting from stress.
- Lessens the risk of lower back pain.
- Reduces exercise associated soreness.
- Improves blood flow to muscles.
- Lessens the risk of activity related injuries.

Movement at a joint can increase its flexibility; lack of movement can reduce it. That is one reason that exercisers feel “loose” after activity, whereas sedentary people tend to feel stiff and have difficulty bending. Flexibility at a particular joint can be fostered by specific stretching exercises (American Physical Therapy Association, 2021). Each joint’s flexibility is independent of other joints; that is, you can be more flexible at one joint than you are at another. Activities such as yoga and t’ai chi ch’uan, which are discussed next, help increase flexibility at many joints simultaneously.

It is best to do stretching exercises when the muscles are warm. You should stretch to the point of mild discomfort but stop immediately if you experience pain—particularly in the lower back or knees. Hold all stretches for 15 to 30 seconds, rest for 30 to 60 seconds, and then repeat the stretch, trying to go a little further. For all standing stretches, legs should be hip width apart, with knees slightly bent, back straight, and weight evenly distributed from the front to the back of the feet.

Yoga is a system of exercises formulated in India thousands of years ago to unite one’s mind and body. The word *yoga* means to join or yoke together. Of the several kinds of yoga, the most common is *Hatha yoga*, which uses body postures called poses or *asanas*, breathing techniques (*pranayama*), and meditation to bring the body, mind, and spirit into healthy harmony. In yoga practice, one pays attention to the physical, mental, and spiritual effects of doing each posture (called *observing*). Also, yoga’s breathing techniques increase a sense of positive energy and minimize negative inner self talk. About 36 million U.S. adults practice yoga each year.

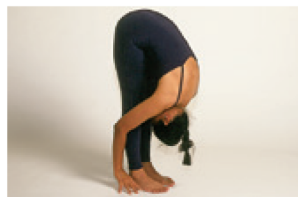
Yoga is best learned from an experienced practitioner. The method is generally practiced for 30 minutes at a time, two or more days a week. A combination of postures called the Sun Salute (**Figure 7.8**) can be done daily to increase flexibility and bring the mind and body into harmony (Folan, 2015). The principal physical benefits of yoga are enhancing muscular fitness and body flexibility; the exercises are not sufficiently strenuous to produce significant cardiovascular benefit. Nevertheless, yoga can help reduce risk factors for cardiovascular disease, high blood pressure, and diabetes. It also helps reduce symptoms of osteoarthritis.



Position 1 Stand erect with your feet hip width apart and palms together in front of your chest. Inhale and exhale slowly and calmly.



Position 2 Inhaling, raise your arms above your head, palms facing in. Lengthen through the spine but do not arch your back.



Position 3 Exhaling, bend forward from the hips, keeping your arms extended and your head hanging loosely between them. Keep your legs slightly bent and relax your neck and shoulders.



Position 4 Inhaling, bend both knees and place your palms flat on the floor by the outsides of your feet. Extend your left leg back. Stretch your chin toward the ceiling.



Position 5 Continue while holding the breath if you can—don't strain. Reach your forward leg back next to the other leg. Hold your body straight, supported by your hands and toes, with ankles, hips, and shoulders in a straight plane.



Position 6 Exhaling, lower your knees, chest, and chin or forehead to the floor, keeping your hips up and toes curled under.



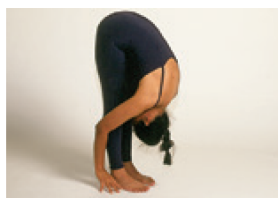
Position 7 Inhaling, bring the tops of your feet to the floor, straighten your legs, and come up to straight arms, opening the chest and stretching your chin toward the ceiling. Be careful not to overarch your lower back.



Position 8 Exhaling, curl your toes under and raise your hips into an inverted "V." Push back with your hands and lengthen your spine by reaching your hips upward. Keep your head hanging loosely.



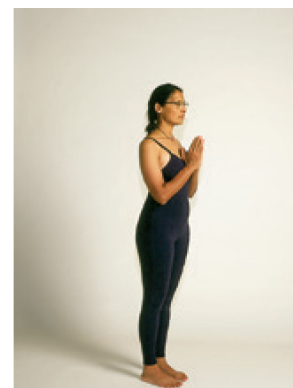
Position 9 Inhaling, lift your head and bring your left leg between your hands, keeping the right leg back. Raise your chin toward the ceiling.



Position 10 Exhaling, bring your left foot forward so your feet are together. Bend forward from the hips, keeping your legs slightly bent and your upper body relaxed. If you can, touch your head to your knees and place your palms beside your feet.



Position 11 Inhaling, slowly straighten up with your arms extended above your head. If you have any lower back pain, be sure to bend your knees.



Position 12 Exhaling, bring your hands together in front of you. Close your eyes for a moment and feel the sensations in your body.

Figure 7.8 The Sun Salute. This Hatha yoga exercise is a series of 12 postures, or asanas, which are intended to be done in one flowing routine. Each of the 12 postures is held 3

seconds. Many good Sun Salute videos can be viewed online.

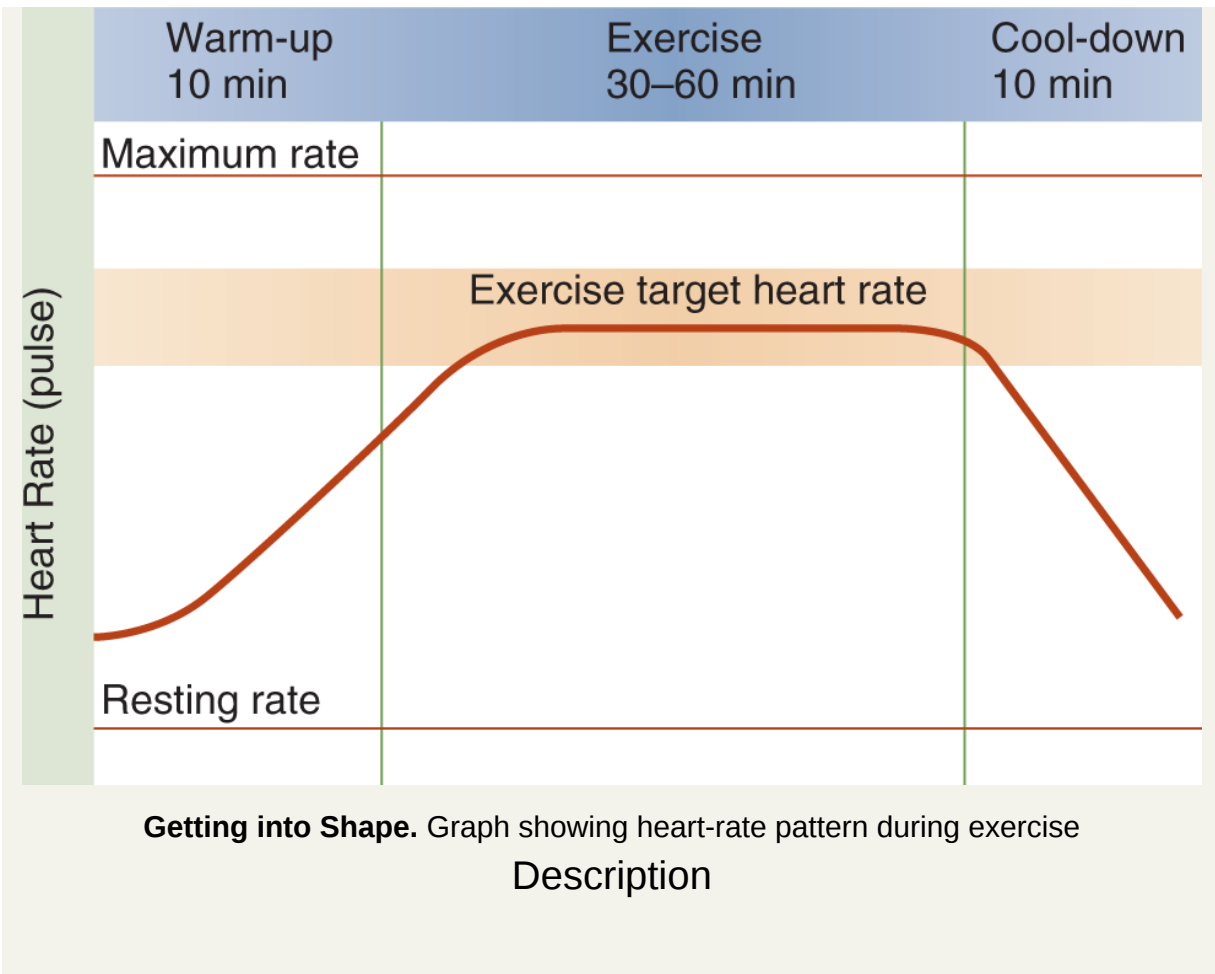
Description



Getting into Shape

Undertake a program to increase aerobic conditioning by following these guidelines.

1. *Frequency:* You should exercise three to five times a week.
2. *Intensity:* You should exercise within 60% to 80% of your exercise target heart rate.
3. *Time:* You should exercise within your exercise target heart rate for 20 to 60 minutes each time.
4. *Type of exercise:* Appropriate exercises are rhythmic and continuous and use the large muscles of the legs and hips. Such exercises include walking, jogging, bicycling, swimming, cross-country skiing, and aerobic dancing.
5. *Warm up and cool down:* It is optimal to raise the body's core temperature about 1°F to 3°F by doing the warmup and stretching activities before the aerobic workout. After the aerobic workout, you should slow your heart rate and cool down for 30 to 60 minutes. Optimal time to stretch is when the muscles are warmed (i.e., after aerobic exercise).



Besides building strength and flexibility, yoga enhances well-being, mood, attention, mental focus, and stress tolerance. It can lessen sleep problems. Yoga is a beneficial, low-risk, low-cost adjunct to the treatment of stress, anxiety, posttraumatic stress disorder, depression, stress-related medical illnesses, substance abuse, and rehabilitation of criminal offenders (Saeed, Cunningham, & Bloch, 2019).

T'ai Chi Ch'uan

T'ai chi ch'uan is based on a system of martial arts. In practicing t'ai chi, the individual concentrates on moving the joints of the body freely and developing internal energy. The practice of t'ai chi can be an ideal way of improving your health and staying in shape. There are several major styles of t'ai chi (named after the families that

founded them) and great variation within each style. All t'ai chi forms are low impact, improve balance and coordination, increase mobility, and reduce stress.

T'ai chi is best learned from a teacher because it is difficult to learn from a book or video. Some teachers practice the martial aspects of t'ai chi, which can include self-defense applications of movements from the t'ai chi form. You need not become a great fighter to benefit from practicing t'ai chi.

T'ai chi can offer immediate benefits, but it takes many years to become highly skilled. Beware of teachers who say that they have secrets or shortcuts. It is your own diligent practice that will bring you the full benefits of t'ai chi. The teacher is there to show you the way.

Body Composition

Body composition refers to the relative amounts of the body's major constituents—that is, water, protein (called the *fat free mass*), minerals (including the calcium and phosphate in bones), and essential and storage fat. Two health concerns relating to body composition are body fat percentage and bone density.



T'ai chi exercises help maintain physical fitness and mind–body harmony.

© Kali9/E+/Getty Images

Body Fat Percentage

The body has two kinds of fat: essential fat to carry out life functions and storage fat to supply energy. The healthy range for the amount of storage fat for nonathletic, young adult males is between 10% and 20% of the total body weight. Because of differences in sex hormone biology, the healthy range for the amount of storage fat for nonathletic, young adult females is 15% to 30% of the total body weight. Greater or lesser body fat percentages can be a risk to health.

Bone Density

From a health perspective, one wants bone density of about 4% of total body weight; low bone density, such as in osteoporosis, increases the risk of falls and bone fracture. Healthy bone density is achieved by engaging in regular weight-bearing exercise, consuming

adequate amounts of calcium and phosphate, and consuming little or no phosphate-containing sodas. Bone density in adulthood is largely determined when one is young, which is the reason young people are encouraged to exercise, consume dairy foods, and to avoid consuming sodas.

Physical Activity Among College Students

According to the American College Health Association (2020), about 60% of North American college students acquire less than the recommended amounts of physical activity. Like many in the general adult population, North American college students carry out most of their daily tasks while sitting—in lectures, at libraries, and studying. Many student jobs involve sitting at desks or standing behind counters (restaurant servers who walk a lot are exceptions). During nonschool and nonwork leisure time, many students watch TV, listen to music, play video games, or involve themselves in social media and the Internet. Travel is often by car.

Most college students know they should be more physically active, but they encounter a variety of barriers to doing so. For example, many students believe that health-promoting physical activity should be vigorous, frequent, and prolonged; they mistakenly imagine that physical activity for health requires lengthy workouts at a gym or running nearly every day—a serious time investment that many cannot realistically make. Moreover, whereas many college students were active in sports while in high school, they find exercise for its own sake to be boring and even unpleasant. Furthermore, if exercise facilities are crowded or otherwise uninviting, or the campus community is perceived as unsafe, students are less likely to go out to exercise. Perceiving these barriers as insurmountable, students give up on putting physical activity in their lives altogether.

So, if you actively participate in sports or are otherwise moving your body around for at least half an hour a day on most days of the week in any way you can, keep doing it. If not, find ways to do so and not necessarily by taking up a sport or exercising vigorously. A “just do it” attitude, buying new exercise clothes and shoes, and going to a gym several times a week (especially at odd hours) are unnecessary and unlikely to be maintained for long. It’s better to get into the habit of walking for 30 minutes almost every day.

Remember, moderate amounts of physical activity are sufficient to promote health and reduce stress. Your goals are to find activities that you enjoy, that you can work into your schedule, and that you can make a regular part of your life.

Integrating Physical Activity in Your Life

Some individuals enjoy movement. Others, however, are not so inclined. To gain its health benefits, they must find pleasant (not distasteful) ways to integrate physical activity into their lives. This is especially true for those whose lifestyles are sedentary. Anything they can do to increase their amount of movement each day produces multiple rewards. Indeed, the greatest health gains derive from going from a sedentary to a moderate degree of daily physical activity (Figure 7.4).

Here are some guidelines for incorporating physical activity into your life.

1. *Define specific goals.* Goals can be general or specific. For example, “I want to be in shape” or “I want to lose weight” are general goals. “I want to walk 9,000 steps a day” or “I want to run a mile 4 days a week” are specific goals. Include among your goals that you want to do activities that you enjoy and that you want to make a regular part of your life for the long term. If you are unsure about your exercise goals, then set as a goal to make some more specific goals by experimenting with three kinds of activity to see what each offers.
2. *Research.* Consult books, magazines, the Internet, or teachers, coaches, and health professionals to determine ways to accomplish your goals. Be sure to assess the authoritativeness of the information you acquire; you do not want to undertake an injurious activity or set an unattainable goal and have a failure experience. Because they are not experts, consulting friends may be of limited usefulness.
3. *Make a plan.* Having defined your goals and acquired information on how to accomplish them, make a realistic and feasible plan for putting and maintaining physical activity in your life. Be sure your activity plan fits into your schedule; use a time audit (see Chapter 3) to identify times of the week when you can exercise. Also,

choose activities that are interesting (or likely to be) and enjoyable. That way you are more likely to want to do them. Write down your plan; perhaps discuss it with a coach, teacher, or health professional. Even better, take a class. That way you will learn proper technique, have a built-in schedule, and have the enjoyment of being with others.

4. *Get a physical checkup.* Consult a health professional if you have been inactive for many months or have concerns about your body's ability to perform at the level you want.
5. *Progress slowly.* Deliberate progress enables you to assess the feasibility of your choices and also to integrate them into your normal life routine. Try not to let your enthusiasm for beginning a new plan stimulate you to take on too much too soon. You don't want to get sore or injure yourself.
6. *Track progress.* Keep a diary of your activity. For each activity day, record the time you spent doing the activity, what you experienced doing the activity, any obstacles that prevented you from carrying out a day's activity, and strategies for overcoming any obstacles.
7. *Evaluate.* Each week, ask yourself if your plan is working to accomplish your goals. If so, continue. If not, identify the obstacles and make course corrections, for example, by changing the choice of activities, the time devoted to them, and perhaps even your goals themselves.



When choosing an exercise, pick one that's fun and convenient for you.

Left: © Ingram Publishing/Alamy Stock Photo; center: © Yellowdog/Image Source/Getty Images; right: © Ingram Publishing/Alamy Stock Photo



Walking in Balance

Native Americans have an expression that helps us understand our place in the physical world. The expression “walking in balance” means engaging your body with your mind in the natural world, feeling a sense of connectedness with nature. Walking in balance suggests that we combine the powers of the mind and body to become more aware of ourselves in our environment.

During your next workout try this: While you dress and warm up, remind yourself that you are taking time away from your problems and worries—a minivacation, if you will, from daily responsibilities. The mission during this exercise period (preferably walking or running) is to see where you are exercising as if you were seeing it for the first time. Notice the trees, the birds, the clouds in the sky, and so on. Try to feel that you are a part of nature by noticing as much about the natural world as you can.

Performance Enhancing Substances

The saying “Better living through chemistry” aptly describes the intentions of those who use any of a variety of substances called **ergogenic aids** to increase strength and endurance, enhance athletic performance, or bulk up or “body sculpt” to feel better about their physical appearance. Performance-enhancing substances include stimulants to increase alertness and “energy” and to “burn fat,” muscle enlargers, and endurance enhancers. They come in the form of dietary supplements, herbals, over-the-counter, and prescription-only pharmaceuticals, and illegal drugs.

Many people mistakenly assume that because herbs and dietary supplements are marketed as “natural” they are safe. Before taking any kind of herbal or dietary supplement, keep in mind that the U.S. government does not regulate dietary supplements, so consumers cannot be certain that any product conforms to information on the product label. For example, frequently the actual amount per serving (dose) is not as indicated on the label. Also, although manufacturers promise to adhere to manufacturing standards, they are not compelled to do so, and their products may contain impurities and other chemicals not listed on the label. If one eats and exercises healthfully, any kind of ergogenic aid is unnecessary (Edenfield, 2020).

Stimulants

Stimulants commonly used as performance enhancers include amphetamine and similar chemicals, ephedra (ma huang), synephrine (hoodia, bitter orange) and similar chemicals, and caffeine. These substances can induce euphoria, increase alertness, combat fatigue, and, in some instances, reduce appetite. They also increase the risk of heart attack, seizures, and psychotic episodes. Because of their harmful effects, amphetamines are legally

controlled, and ephedra has been banned for sale in dietary supplements.

Energy drinks generally contain a variety of substances purported to increase alertness and endurance and to combat fatigue, including caffeine (and caffeine-like substances such as theophylline); the herb guarana, which contains caffeine; taurine; ginseng; ginkgo; creatine; carnitine; glucuronolactone; and lots of sugar. Research has shown that energy drinks can enhance endurance and mental acuity, but they are less likely to affect muscle strength and power and neuromuscular performance (Guriérrez-Hellin & Varillas-Delgado, 2021).

Muscle Enlargers

Muscle enlargers include protein and amino acid dietary supplements, androgenic anabolic steroids, and human growth hormone. Although new muscle tissue is made of protein, ingesting protein or certain amino acids will not produce new muscle tissue. Muscles grow in response to work, not food. Anyone consuming a balanced diet obtains sufficient protein and amino acids to meet the demands of nearly any kind of exercise; body builders or athletes who need to build considerable strength are exceptions.

Androgenic anabolic steroids (testosterone and similar substances) are used to build muscle strength in women and men. They are legal only by prescription for medical reasons. Androstenedione (*andro*) is a “prohormone” that is converted in the body to testosterone. Prior to 2005, androstenedione and similar substances could be purchased legally as dietary supplements. However, in 2005, the U.S. Food and Drug Administration banned the sale of andro and other testosterone prohormones because they are dangerous. Potential long-term consequences of testosterone use in men include infertility, erection problems, breast development (gynecomastia), heart disease, liver disease, and cancer. In women, steroids can cause male pattern baldness, deepening of the voice, increased facial hair, and abnormal menstrual periods. Children and

young adults who use steroids are at risk for early onset of puberty and premature cessation of bone growth.

Human growth hormone (HGH or GH) is manufactured by the pituitary gland and secreted into the bloodstream. Although reputed to enhance athletic performance by increasing energy or building muscle mass (or both), scientific evidence of any ergogenic effects is lacking (Holt & Ho, 2019). Despite unscrupulous advertising claims to the contrary, HGH cannot be taken orally because it is broken down in the digestive system.

Endurance Enhancers

Endurance enhancers include B vitamins, creatine, and erythropoietin.

Creatine, a natural substance in muscle tissue required for muscle contraction, can be purchased as a nutritional supplement. Some, but not all, studies show that creatine supplementation might enhance short-burst activity such as weightlifting or sprinting. It is not helpful for endurance activities. In doses commonly in use (3 to 5 grams per day), creatine is apparently not harmful. However, because herbs and other nutritional supplements are unregulated, one cannot be sure of the purity or dose of any such product.



Caveat Emptor: The Business of Sports

Supplements

Everyone has heard of professional, Olympic, and other high-level athletes who have been punished for taking banned—and often illegal—substances (e.g., steroids, hormones, and other drugs). Apparently, in a world where winning is everything, some elite athletes are willing to risk their careers and their health to gain a competitive edge.

Unfortunately, a significant number of high school athletes, college athletes, nonathletes, and people who just want to “look good” also take drugs to gain a competitive edge. Among athletes, the edge might be enhanced athletic performance. Or it may be solidifying one’s identity as an athlete or gaining recognition as an athlete

among one's peers. Among the "body conscious," the edge is generally sculpting the body to compete socially for friends and sexual and intimate partners.

The dietary supplement industry is masterful at catering to concerns about competing athletically and socially. Advertising of supplements supports a variety of "fitness" magazines and a host of e-commerce "sports supplement" or "sports nutrition" websites that lure potential consumers with information of dubious authority, all with the intention to sell them something. For example, a body-building website tells visitors about the ban on testosterone prohormones but not to worry because "we have a number of other products that work just as well." The banner of a "sports nutrition" website shows a cluster of several nearly naked, "buff" college-aged men and women, offering a plethora of generally worthless products to enhance performance, increase energy, and lose weight (and look just like the models in the banner). Media depicting muscular, "fit" models influence people to view their own bodies as inferior.

The dietary supplement industry is estimated at \$15 billion a year and is largely unregulated. A federal law in 1994 made it possible for manufacturers of dietary supplements not to adhere to the same testing for safety, efficacy, and purity as required for prescription and over-the-counter medications. With over 60,000 dietary supplements on the market, U.S. government agencies cannot investigate the purity and safety of every batch of a particular supplement, nor can claims made in the advertising of every supplement be evaluated for truthfulness. In the world of dietary supplements, the watchword is *caveat emptor*: Let the buyer beware.

Erythropoietin is a hormone that increases the number of red blood cells, thus increasing the body's ability to carry oxygen to tissues. Erythropoietin is a prescription medication given to people whose bodies cannot produce sufficient blood cells, such as people undergoing cancer treatment. It is used illegally by athletes to increase endurance, especially at high elevations. The drug can be especially dangerous, causing heart attacks and strokes.

Sports Injuries

Regardless of type, physical activity and sports participation carry some risk of injury, whether it's working up a blister while walking in new shoes, pulling a leg muscle while cycling, or jamming a finger in a volleyball game. When an injury occurs, one should apply first aid in the form of **RICE**—rest, ice, compression, and elevation (see the Wellness Guide box "First Aid for Sports Injuries: RICE"). When an injury heals, one should endeavor to prevent the injury (and others)

from occurring again (see the Health Tip box “Preventing Sports Injuries”).



Preventing Sports Injuries

- Strengthen muscles.
- Be physically fit and improve endurance.
- Don't overwork the body.
- Improve body flexibility with stretching exercises before and after activity.
- Be aware of how the body is functioning.
- Be aware of hazards in the environment; use facilities designed for sports activity.
- Use state-of-the-art equipment, particularly athletic shoes, and protective gear.
- Participate only when weather conditions are safe.
- Improve running or playing form; get expert coaching.
- Rehabilitate injuries adequately before returning to activity.

About half of injuries in physical activity occur because some part of or the entire body is being exercised beyond its biological limits. Such injuries are referred to as **overuse injuries**. Commonly, overuse injuries affect the skin and muscles, tendons, ligaments, and joints, which are constructed of fibrous bands of protein (**Table 7.5**). These fibers can be torn if they are overworked, as when lifting a heavy weight or running farther or faster than one should, or when forced to perform when fatigued. Damage can also occur by repeated small injuries that lead over time to a more serious problem. The common causes of overuse injuries are excessive exercising, faulty technique, and poor equipment.

TABLE 7.5 Common Overuse Injuries	
Strain	Commonly referred to as “pulled muscles” or “pulled tendons.” Caused by overstretching, tearing, or ripping of a muscle or its tendon

Tendonitis	Inflammation of a tendon caused by chronic, low-grade strain of a muscle–tendon unit
Bursitis	Inflammation of the lubricating sac that surrounds a joint (bursa) caused by repeated low-grade strain of the joint’s supporting tissues
Sprain	Overstretching or tearing of ligaments
Blisters	Fluid-filled swellings on the skin caused by undue friction from the rubbing of skin against shoes, clothing, and equipment

Long ago when men cursed and beat the ground with sticks, it was called witchcraft. Today it's called golf.

—Will Rogers

All bodies are not anatomically capable of the same degree of physical exertion, especially the high performance exhibited by marathon runners or triathletes. The architecture of the body, the alignment of the legs, the capacity of the lungs, the size and strength of the bones and muscles, and other anatomical factors set limits on an individual’s physical ability. Few people have the biological endowment to perform at championship levels. Physical activity can be much more enjoyable when you respect, accept, and appreciate your body’s biological limits.

Don’t ask your muscles to do more than they can. Relishing the pain of overexertion—“going for the burn”—is dangerous. Pain is the body’s message that something is wrong, not that the exerciser is dedicated and courageous. If you want to increase your performance, progress slowly, following a supervised regimen. Injuries are more likely if equipment such as weights and other kinds of apparatus is used improperly or is in disrepair.



Healthy Hydration

Females: 55% of body weight (BW)

Males: 60% of body weight (BW)

Dehydration

2%–5% BW lost in sweat.

Severe Dehydration

More than 6% of BW is lost in sweat.

Hydration refers to the amount of water in the body. During physical activity, muscles produce heat. Body water is lost as sweat to maintain body temperature. Because hydration also can affect the amount of body sodium, attention to proper fluid also applies to sodium.

Beware of overhydration. Drink only enough water to restore body weight lost as sweat. Too much water can result in dangerous, even life-threatening, sodium loss. (See [Table 7.6](#) for hydration guidelines.)

TABLE 7.6 Hydration Guidelines

When	Quantity	Form
Everyday	1 mL/calorie consumed (2 L = 64 ounces)	Water in food and fluids; let thirst be your guide.
Every 2–4 hours	5–10 mL/kg BW to achieve pale yellow urine	Water, sports drinks (low carb + sodium); salted snacks or small beverages with meals to help with fluid retention. Hyperhydration with water or glycerol increases the need to pee and no performance advantage. Also can lower sodium to dangerously low levels.
During activity	0.4–0.8 L/hr.	Water, sports drinks (maximum of 8% carbs); cold fluid can help in hot environments; flavored fluid encourages consumption.

When	Quantity	Form
After activity	1.25–1.5 L fluid for every 1 kg BW lost	Water; sports drinks. Limit alcohol because of its diuretic effects. Caffeine OK if <180 mg.

Data from American Dietetic Association, Dietitians of Canada, and the American College of Sports Medicine. (2016). Nutrition and athletic performance. *Medicine & Science in Sports and Exercise*, 48, 543–568. Retrieved from http://journals.lww.com/acsm-msse/Fulltext/2016/03000/Nutrition_and_Athletic_Performance.25.aspx.

1	
2	
3	
4	
5	
6	
7	
8	

PROPERLY HYDRATED

If your urine matches the colors 1–3 (above the red line), you are properly hydrated and should continue to consume fluids at the recommended amounts

DEHYDRATED

If your urine matches the colors 4–8 (below the red line), you are dehydrated and at risk for cramping and heat illness!

YOU NEED TO DRINK
MORE WATER OR SPORTS DRINK

Are You Hydrated? Take the Pee Test.

Description

Most people participate in physical activity because they want to have fun, gain a sense of accomplishment by doing something well, and feel physically and psychologically better. While pursuing these goals, no one wants to be hurt. It turns out that maximizing the “have fun, do well, feel good” aspects of physical activity and minimizing the potential for injury go together.

Physical Activity in Cold and Hot Weather

Your body is designed to maintain its operating temperature at 37 °C (about 98 °F). Because heat always moves toward cold, your body loses heat in cold environments and absorbs heat in warm environments. Moreover, exercised muscles produce heat, which can elevate body temperature. Sweating is the evaporation of body water to rid the body of excess heat.

Cold Stress

Overexposure to cold, windy, and wet weather may lead to an abnormally low body temperature (hypothermia). Symptoms of hypothermia include shivering, muscle weakness, numbness, drowsiness, and occasionally unconsciousness. In instances of cold stress, get out of the cold environment and seek protection from the wind. Gently remove wet clothes and replace them with dry ones. Rewarm the body by immersion in warm (105–110 °F; 41–43 °C) water and wrapping in warm blankets. Do not consume alcohol “to warm up” because alcohol dilates arteries and causes heat loss. Seek medical attention as soon as possible.

Frostbite is the freezing of tissues with the formation of ice crystals in the fluid around cells and blood vessels. Frostbitten skin may become white or grayish yellow. The onset of frostbite is usually painful, but pain generally diminishes and the region becomes cold and numb. Gently rewarm a frostbitten region and seek medical attention as soon as possible.

To prevent cold stress during exercise follow these recommendations:

- Dress appropriately for cold weather. Wear no more than three layers of clothing; be sure all layers can be opened if necessary to cool the body overwarmed by vigorous exercise.

- Wear mittens rather than gloves to allow the fingers to insulate each other.
- Wear appropriate thermal head covering.
- Keep the feet warm and dry.
- Be prepared to change into warm, dry clothes quickly.



First Aid for Sports Injuries: RICE

Most sports injuries involve the release of fluids and other substances from damaged tissues. Immediate treatment of a sports injury, therefore, requires limiting any swelling and internal bleeding by administering RICE—rest, ice, compression, and elevation.

Rest: Resting and possibly immobilizing an injured region prevents additional tissue damage and limits internal bleeding.

Ice: Cool an injured region immediately with crushed ice or ice cubes wrapped in a towel (to avoid frostbite), a cold pack, or a bag of frozen peas or corn. The cold reduces swelling, internal bleeding, and pain. Cool for 30 minutes. Allow the region to warm for 15 minutes, and then cool again.

Compression: Wrap the injured region with an elastic bandage to control swelling. Be careful not to wrap so tight as to turn the skin pale or cause lack of sensation.

Elevation: Raise the injured region to limit swelling and internal bleeding.

Heat Stress

Heat stress results from the loss of considerable body water and minerals from sweating and dehydration and the unavailability of sufficient body water to cool the body through sweating. Types of heat stress include the following.

Heat cramps: painful, constant contraction of one or more muscles. Stop activity, replace water and minerals by drinking water or dilute fruit juice; massage and stretch cramping muscles; and rest and cool the body before returning to activity.

Heat exhaustion: weakness, nausea, dizziness. Stop activity; lie down and elevate the legs 12 to 18 inches; replace water and minerals by drinking water or dilute fruit juice; and cool the body with wet cloths and by going to a cool room. Rest for several days before returning to activity. Consult a physician.

Heat stroke: high body temperature (105°F/41°C), disorientation, alteration in normal mental status, unconsciousness. Stop activity, remove clothes, and cool the body with cold water or ice packs. Replace water and minerals by drinking water or dilute fruit juice. Seek medical attention immediately.

To prevent heat stress during exercise follow these recommendations:

- Acclimate to exercising in hot, humid environments by gradually increasing the level of physical activity over the span of several days.
- Be wary of overexertion in hot and humid conditions. Heat stress may occur rapidly.
- Drink lots of fluid (water, dilute fruit juice, or sports drinks) before activity and regularly during extended activity. Do not rely on thirst to signal fluid loss or high body temperature.
- Wear light-fitting, light-colored clothing made of breathable fabric and a light-colored cap and sunscreen to limit sun exposure.
- Exercise during the coolest times of the day (morning and evening) and in the shade.

Sport-Related Concussion

A **concussion** is a medically specific form of a **traumatic brain injury** that results from a bump, blow, or jolt to the head or body that causes the head and brain to move rapidly back and forth. This sudden movement can cause the brain to bounce around or twist in the skull, creating chemical changes in the brain and sometimes damaging brain cells. Concussions may cause problems with thinking, emotions, sensation, language, memory, communication, personality changes, depression, and the early onset of dementia. Many concussions are not life threatening; however, the effects of a concussion can be serious (**Table 7.7**).

TABLE 7.7	Signs and Symptoms of Concussion
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-
- Can't recall events prior to or after a hit or fall.
 - Appears dazed or stunned.
 - Forgets an instruction, is confused about an assignment or position, or is unsure of the game, score, or opponent.
 - Moves clumsily.
 - Answers questions slowly.
 - Loses consciousness (even briefly).
 - Shows mood, behavior, or personality changes.
 - Headache or "pressure" in head.
 - Nausea or vomiting.
 - Balance problems or dizziness, or double or blurry vision.
 - Bothered by light or noise.
 - Feeling sluggish, hazy, foggy, or groggy.
 - Confusion, or concentration or memory problems.
 - Just not "feeling right," or "feeling down."
-

U.S. Centers for Disease Control and Prevention. (2019). Concussion Signs and Symptoms. Retrieved from https://www.cdc.gov/headsup/basics/concussion_symptoms.html.

Repeated blows to the head such as occur in contact sports (football, soccer, hockey, boxing) can cause long-term damage to the brain even without concussions, a phenomenon known as **chronic traumatic encephalopathy (CTE)**. CTE involves destruction of nerve cells in the brain that cause declines in recent memory and thought processes, depression, impulsivity, aggressiveness, anger, irritability, suicidal behavior, and eventual progression to dementia. Initial signs and symptoms generally do not appear until many years after the brain trauma has occurred. Many retired football and ice hockey players have CTE.

Sport-related concussions are common among female and male athletes in the United States (Pierpoint & Collins, 2021). Contact sports (women's and men's hockey, football, men's wrestling, men's and women's rugby) present the greatest vulnerability to brain injury. Sports in which player-to-player and player-to-equipment collisions occur frequently (basketball, soccer, lacrosse) also increase vulnerability to concussion. Sports organizations have become increasingly concerned about competitors' risks for brain injury, and most are supporting risk-reduction efforts such as rule changes, changes in coaching methods, better protective equipment, and much unproved medical intervention at the first sign of head trauma (U.S. Centers for Disease Control and Prevention, 2020).

Critical Thinking About Health

Another Christmas day at Grandma's. Well, almost. After everyone had eaten all they possibly could and all the children had ripped open their Christmas gifts, Suzanne's Uncle Ron sat next to her on the couch.

"I understand that you're taking a health class at school," he said.

"That's right," Suzanne replied.

"Then tell me," Uncle Ron continued, "what's the best exercise? My New Year's resolution is to get back in shape, and I want to do it right this time. I'm joining the gym on January 2. What workouts do you recommend?"

1. What advice should Suzanne give her uncle? Take into account that Uncle Ron has tried working out before, apparently without success. Uncle Ron is a 39-year-old telecommunications engineer who works long hours at a computer terminal when he's at his office. His job also requires him to travel, so he eats a lot of fast food. He is married and has three young children.
2. What are the effects on society and on organized sports of athletes using performance-enhancing drugs, even when such substances are legal?
3. How far? How fast? How much? How might questions such as these affect a person's attitude and approach to physical activity for health (i.e., not competition)? List a new set of questions that illustrate a noncompetitive perspective on physical activity for health.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Many people enjoy exercising and participate in some form of regular exercise. Many more do not and live sedentary lives with little body movement other than getting off the couch and into bed. As famous comedian W. C. Fields quipped, “Every time I think about exercise I lie down until the thought passes.” To entice people to exercise more, a vast exercise and sports industry has created exercise machines of all kinds, 24-hour gyms, spas, competitions, and classes in exercise dance (zumba), yoga, t'ai chi, Pilates, and many others.

For many people, life has become so busy that there simply is no time to even think about exercising. If you are among those without time to exercise, you need to rethink your priorities. Taking an extra 30 to 60 minutes a day to walk instead of drive can constitute a major step (pun intended) toward better health. All exercise involves sustained movement to increase flexibility, strength, and endurance. The most important aspect of making the decision to exercise is commitment. Just as you devote effort to accomplishing other goals, like graduating from college, you need to make the same kind of strong commitment to move your body.

Modern society puts many obstacles in the path of daily movement activity. Work at a job, schoolwork, and time spent on social media, playing video games, watching movies, and texting friends are many ways we can use time every daytime that could be used for movement. Begin now to figure out a way to exercise. Begin with small steps, perhaps a 20-minute walk or jog around the neighborhood. Walk your dog. Go to the nearest park and do the exercises you learned in gym a long time ago. Exercise restores awareness, improves concentration, and makes you more self-assured in social interactions. Start slowly. Pay attention to your

body. Loosen up before vigorous exercise. Remember to slow down and cool down when you are finished. Here we go! Enjoy.

HIGHLIGHTS

- Many people live sedentary lives because machines carry out most of the physical labor of living. Sedentariness is associated with a variety of risks to health, which is the reason governments and social institutions are seeking ways to help individuals increase the amount of physical activity in their lives.
- Physical activity is any kind of movement, including doing household tasks, work-related movement, leisure time activities, and performance-based activities.
- Physical activity is measured as calories of energy expended per minute, metabolic equivalents (METs), and physical activity level (PAL).
- Moderate, rather than vigorous, amounts of physical activity are sufficient for health. Experts recommend walking briskly for 30 minutes on most days of the week.
- Physical activity has six components: motivation, cardiorespiratory fitness, body strength, endurance, flexibility, and body composition.
- Guidelines for integrating physical activity into life involve goal setting, developing and carrying out a plan, and tracking and evaluating progress.
- Performance-enhancing substances include stimulants (e.g., amphetamines, caffeine), muscle enlargers (e.g., androgenic anabolic steroids), and endurance enhancers (e.g., creatine).

- The most common cause of sports injury is exercising a body part or the entire body beyond its biological limit to the point of injury. Common injuries include strain, tendonitis, bursitis, sprain, and blisters.
- Exercising in hot or cold weather requires taking special precautions to prevent injury and illness.

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KEY TERMS

sedentary behavior:

a pattern of living that lacks sufficient physical activity for good health

anaerobic:

biological energy production without using oxygen

aerobic:

biological energy production using oxygen

oxidation:

the chemical term for the process by which oxygen is used to produce energy for life processes.

metabolic equivalents (METs):

per minute multiples of the amount of energy used while lying still

physical activity level (PAL):

a measure of the amount of energy expended per day over and above that used for basal metabolism

relative perceived exertion:

awareness of one's relative response to exercise

pedometer:

a step counter

cross-training:

incorporating more than one activity into a regular activity plan

cardiorespiratory fitness:

the degree to which the body can supply sufficient fuel and oxygen to produce sustained, effortful physical activity

aerobic training:

exercise that increases the body's capacity to use oxygen

training effect:

beneficial physiological changes as a result of aerobic exercise

target heart rate:

the heart rate during strenuous exercise associated with inducing the training effect

strength training:

the use of resistance to increase one's ability to exert or resist force for the purpose of improving performance

isometric training:

strength training by pushing against an immovable object

Pilates:

a system of stretching and strengthening exercises

endurance:

the ability to move an object without becoming quickly fatigued

flexibility:

the degree to which one can rotate, bend, and twist a part of the body

range of motion:

the amount of rotating, bending, or twisting allowed by the anatomy of a joint

yoga:

a system of exercises formulated in India thousands of years ago to unite one's mind and body

t'ai chi ch'uan:

a Chinese martial arts system of movements that enhances freedom of movement and focus of mind

body composition:

the relative amounts of the body's major components

ergogenic aids:

substances used to increase strength and endurance

androgenic anabolic steroids:

synthetic male hormones used to increase muscle size and strength

human growth hormone (HGH or GH):

a naturally occurring pituitary hormone

creatine:

a natural substance in skeletal muscle tissue required for muscle contraction, which can also be purchased as a dietary supplement

erythropoietin:

a hormone that increases the number of red blood cells, thus increasing the body's ability to carry oxygen to tissues

RICE:

an acronym for rest, ice, compression, elevation; the first aid measures for sports injuries

overuse injuries:

injuries to muscles, tendons, ligaments, and joints resulting from too much exercise

concussion:

a blow to the head that causes injury, temporary loss of consciousness, and possibly a period of amnesia upon awakening

traumatic brain injury (TBI):

injury caused by a bump, blow, or jolt to the head that results in impaired thinking or memory, altered movement or sensation, personality changes, or emotional problems such as depression

chronic traumatic encephalopathy (CTE):

destruction of nerve cells in the brain from repeated brain injury due to collisions and falls



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CHAPTER 8

Healthy Sexuality

Preventing Unintended Pregnancy and STDs



Health Tips

Vaginal Health

Five Ways to Practice Fertility Awareness

Condom Sense

If You Missed Taking Your Hormonal Contraceptive

Talking About Possible STD Exposure with a Sexual Partner



Wellness Guide

A Comparison of Contraceptive Methods

Home Pregnancy Testing

Self-Care: Wise Speech

LEARNING OBJECTIVES

1. List five reasons for using fertility control.
2. Define typical and lowest observed failure rate for several fertility-control methods.
3. List and describe four methods of combination hormonal contraception.
4. Describe two types of progestin-only contraception.
5. Explain how an intrauterine device (IUD) is used to prevent pregnancy.
6. List and describe five barrier methods of contraception.
7. Describe four fertility-awareness methods of contraception.
8. Explain why many people do not use fertility-control methods.
9. List the five most common sexually transmitted infections in North America.
10. List the nine risk factors for acquiring a sexually transmitted disease (STD).
11. Describe how to practice safer sex and some common barriers to practicing it.
12. Identify the causative agents, symptoms, and treatments for the following STDs: trichomoniasis, gonorrhea, chlamydia, genital herpes, and anogenital warts.

Healthy, responsible sexuality is as important to health and well-being as maintaining a healthy diet, getting adequate exercise, and being tobacco and drug free. The World Health Organization (2020) defines healthy sexuality as

“a state of physical, mental, and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction, or infirmity. Sexual health requires a positive and respectful approach to sexuality and sexual relationships as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination, and violence. For sexual health to be attained and maintained, the sexual rights of all persons must be respected, protected, and fulfilled.”

From the standpoint of personal health, sexuality and sexual relating represent aspects of life over which individuals have considerable control. They can adopt behaviors that contribute to having both a healthy sexual body and healthy sexual attitudes that promote individual and social well-being, choose which feelings to express in sexual ways and whom to express them, and how to avoid the subjects of this chapter: unintended pregnancy and sexually transmitted diseases.

Preventing Unintended Pregnancy

Because people have sexual intercourse for a variety of reasons other than to produce children (**Table 8.1**), for thousands of years they have been attempting to separate the sexual and reproduction outcomes of sexual activity. For example, the ancient Egyptian Ebers Papyrus (~1550 BCE) advised making a paste consisting of bark from the acacia tree, dates, and a bit of honey, then dipping a ball of wool into the paste and placing it in the vagina. Other ancient methods include douching with water, vinegar, or mixtures of plant and animal substances; drinking potions; having the woman jump or sneeze after intercourse; placing a paste made of honey and crocodile or elephant dung (for strength) in the vagina, and some methods still in use today: the man not ejaculating (called *coitus reservatus*), not ejaculating in the vagina (called *coitus interruptus*), and prayer. In the past 150 years, scientific knowledge of human reproductive biology and modern biotechnology have produced an array of relatively safe, reliable methods to help reduce the risk of unintended pregnancy (see the Wellness Guide box, “A Comparison of Contraceptive Methods”).

TABLE 8.1

Reasons for Sexual Activity Given by American College Students

Reason	Examples
Reproduction	To have children
Curiosity and adventure	How will this feel? What’s that person like? What would it be like to ___ with _____?
Sexual release	Feeling “horny” Relief of sexual tension

Reason	Examples
Love and intimacy	<ul style="list-style-type: none"> To communicate as a couple To express love To feel emotionally close
Other reasons	<ul style="list-style-type: none"> To prove one's femininity or masculinity To maintain the relationship Duty To control another To abuse another To make money To relieve stress To relieve boredom To relieve loneliness To have fun To give and receive comfort To gain a sense of accomplishment To prove one's attractiveness To prove adult status To gain or maintain acceptance in a social group (peer pressure)

In the United States, about 65 million women are between ages 15 and 44, the most fertile stage of their lives (Daniels & Abma, 2020). Of this group, about 65% are sexually active and take steps to avoid unintended pregnancy for a variety of reasons (**Table 8.2**). About 17% are not sexually active or regularly sexually active, about 8% are already pregnant, just had a baby, or want to get pregnant; and about 11% cannot get pregnant for biological reasons or do not take steps to avoid pregnancy. About one-third of American college students report having had vaginal sexual intercourse in the prior 2 weeks; more than 80% took some action to avoid unintended pregnancy the last time they had sex (American College Health Association, 2020) (**Table 8.3**).

TABLE 8.2 | **Some Common Reasons for Preventing Pregnancy**

Reason	Explanation
Enhancing sexual pleasure	Anxiety about the possibility of pregnancy can divert a person's attention from the sexual experience and interfere with the flow of sexual feelings. Also, worry during intercourse can cause difficulties with erection and ejaculation in men and with vaginal lubrication and orgasm in women.
Family planning	Safe, reliable fertility control affords couples the opportunity to plan the size of their family and the timing of their children's births. Couples can have children when the family's financial, personal, and social resources are sound and the parents' relationship is ready for raising a child or children.
Increasing women's life choices	Fertility control allows women to choose when to devote time and energy to various life pursuits, including parenthood. In the not-too-distant past, when fertility-control methods were unreliable, it was difficult for a woman to integrate her personal goals with parenthood because she had little control over the timing of the births of her children.
Health considerations	Fertility control helps couples reduce the risk of passing a hereditary disease to children. Fertility control also is advantageous to women for whom pregnancy and childbirth may be a significant health risk. Fertility control can prevent pregnancy in teenagers, who experience more pregnancy-related problems than older women.
World overpopulation	Some couples keep their families small because they want to take some responsibility for limiting the growth of the human population. Some people fear that overpopulation will create pressures for food, water, living space, energy, and other resources.

TABLE 8.3 | **Contraceptive Behavior of American College Students**

	Male (%)	Female (%)
Had vaginal intercourse in past 30 days	35	42
Used protection last time had vaginal intercourse	88	83

	Male (%)	Female (%)
Method		
Pill	55	53
“Shot”	2	2
Implant	9	8
Patch	1	1
Ring	2	2
IUD	13	14
Male condom	57	50
Female barrier	0	0
Spermicide	5	3
Fertility awareness	3	4
Withdrawal	19	23
Sterilization	1	1
Used emergency contraception in last 12 months	16	19
Unintentionally pregnant	1	1

Data from American College Health Association (2020). *American College Health Association-National College Health Assessment III, Undergraduate Student Reference Group Data Report Spring 2020*. Silver Spring, MD: American College Health Association.

How Pregnancy Occurs

Every pregnancy begins with **fertilization**, which is the fusion of a male’s sperm cell with a female’s ovum to form a fertilized egg. Sperm are continuously produced in the pair of testes (about 170

million a day). It takes about 73 days for an immature sperm cell to develop into a mature sperm capable of fertilizing an ovum. Prior to release from a man's body at ejaculation, sperm mix with seminal fluids to comprise the milky white semen emitted at ejaculation. By volume, semen is about 5% sperm and the rest seminal fluid.



A Comparison of Contraceptive Methods

<i>Low Effectiveness*</i>	Method	Advantages	Disadvantages
	Withdrawal	No health problems.	Requires considerable ejaculatory control.
	Spermicides	No health problems; no prescription required.	Must be used with each incidence of intercourse; messy.
	Fertility awareness	No health problems.	Difficult to predict "safe" days; several days of abstinence may be required.
	Female condom	No prescription required.	Vaginal irritation; must be used prior to intercourse.
<i>Moderate Effectiveness†</i>	Male latex condom	No health problems; no prescription required.	May break or tear.
	Diaphragm	No health problems.	Must be used before intercourse; must be fitted by a clinician.
	Cervical cap	Can remain in place for up to 24 hours.	Must be fitted by a clinician; cervical irritation.
<i>High Effectiveness‡</i>	Combination hormonal methods (pills, patch, ring, injection)	Easy to use; not intercourse dependent.	Side effects; serious risks to health in some users.
	Progestin-only methods (mini-pill, injection)	Easy to use; not intercourse dependent.	Side effects
	IUD	Not intercourse dependent.	Side effects; irregular bleeding, heavy menstrual bleeding and cramps; increased risk of pelvic infection.
	Surgical sterilization (tubal ligation; vasectomy)	One-time procedure	Some postsurgical discomfort.

*Low effectiveness: Failure rate greater than 20%.

†Moderate effectiveness: Failure rate between 6% and 19%.

‡High effectiveness: Failure rate between 0% and 5%.

Description

The penis is normally soft, but when a man becomes sexually aroused, its internal tissues fill with blood and the penis enlarges and becomes erect (to facilitate intercourse). All men are born with a fold of skin, the *foreskin*, that covers the end of the penis. In the United States today, parents of male infants can elect to have the foreskin removed surgically within hours after a child's birth, a process called *circumcision* (American Academy of Pediatrics, 2021).

The principal female anatomical contributions to initiating a pregnancy are producing a fertilizable ovum and providing a structure (a **fallopian tube**) in which fertilization can take place. Fertilizable ova are produced in the **ovaries**, two almond-sized organs located in the lower abdomen (**Figure 8.1**). About every 28 days, one ovum—sometimes two—matures to become ready for fertilization. A mature ovum leaves the ovary by a process called *ovulation* and enters one of the pair of fallopian tubes where fertilization usually takes place. Once freed from the ovary at ovulation, an egg can survive for about 24 hours. Each fallopian tube is attached to one side of the uterus, a pear-shaped organ about the size of a woman's closed fist. The uterus is where the fertilized ovum develops into a fetus.

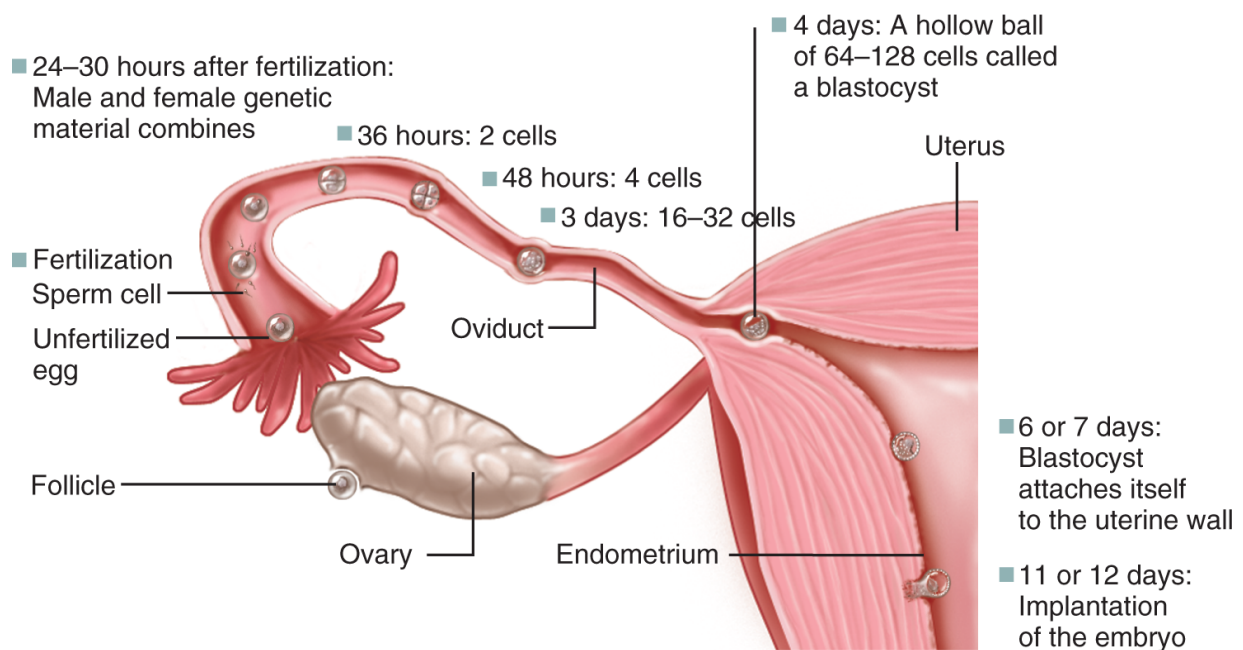


Figure 8.1 Fertilization and Early Development of the Embryo. A mature ovum is released from the ovary about every 28 days and survives for about 1 day. Should ejaculation take place in the vagina within a week prior to egg release (*ovulation*), some sperm will have made their way to the fallopian tubes, one of which will contain the recently released egg. The fusion of a sperm and the ovum is fertilization. After fertilization, the fertilized egg (called a *zygote*) travels down the fallopian to the uterus, where fetal development and pregnancy take place.

Description

An opening in the lower part of the uterus called the **cervix** permits sperm to pass from the vagina to the uterus and a fetus to the outside at birth. Most of the time, fluid produced by glands in the cervix is dense. This thick cervical mucus is a barrier to sperm and microorganisms. Near the time of ovulation, the cervical mucus becomes more fluid, attaining the consistency of egg white, and it becomes organized into channels that orient sperm movement toward the uterus. Some women use the change in consistency of the cervical mucus as a sign that ovulation is taking place and to refrain from unprotected intercourse at that time.

Within seconds following ejaculation in the vagina, some sperm move through the cervix and uterus and into the fallopian tubes. The majority of sperm, however, become trapped in coagulated semen in the upper portion of the vagina. After about 20 minutes, the coagulated semen liquefies and sperm move into microscopic folds in the cervix. Weak or abnormal sperm are unlikely to move beyond the cervix. Healthy, motile sperm tend to be released into the uterus continuously throughout the ensuing 48 hours. Several hundred sperm capable of fertilization eventually approach an ovum, but only one succeeds in penetrating the ovum's outer covering to effect fertilization.

During the first three days after fertilization, the embryo moves along the fallopian tube toward the uterus. It arrives in the uterus about the fourth day after fertilization. Two days later, the embryo attaches to the inner lining of the uterus, and shortly thereafter it

implants in the uterus by eroding the uterine lining. The fetus develops over the next 9 months until birth.

The Menstrual Cycle

If fertilization does not occur, the lining of the uterus and some associated blood vessels are sloughed off and leave the body via the vagina. This is **menstruation**. At this point, another 28-day process begins to produce a fertilizable ovum and ready the uterus for pregnancy. These near-monthly periods of ovum production are referred to as the woman's **menstrual cycle** (**Figure 8.2**).

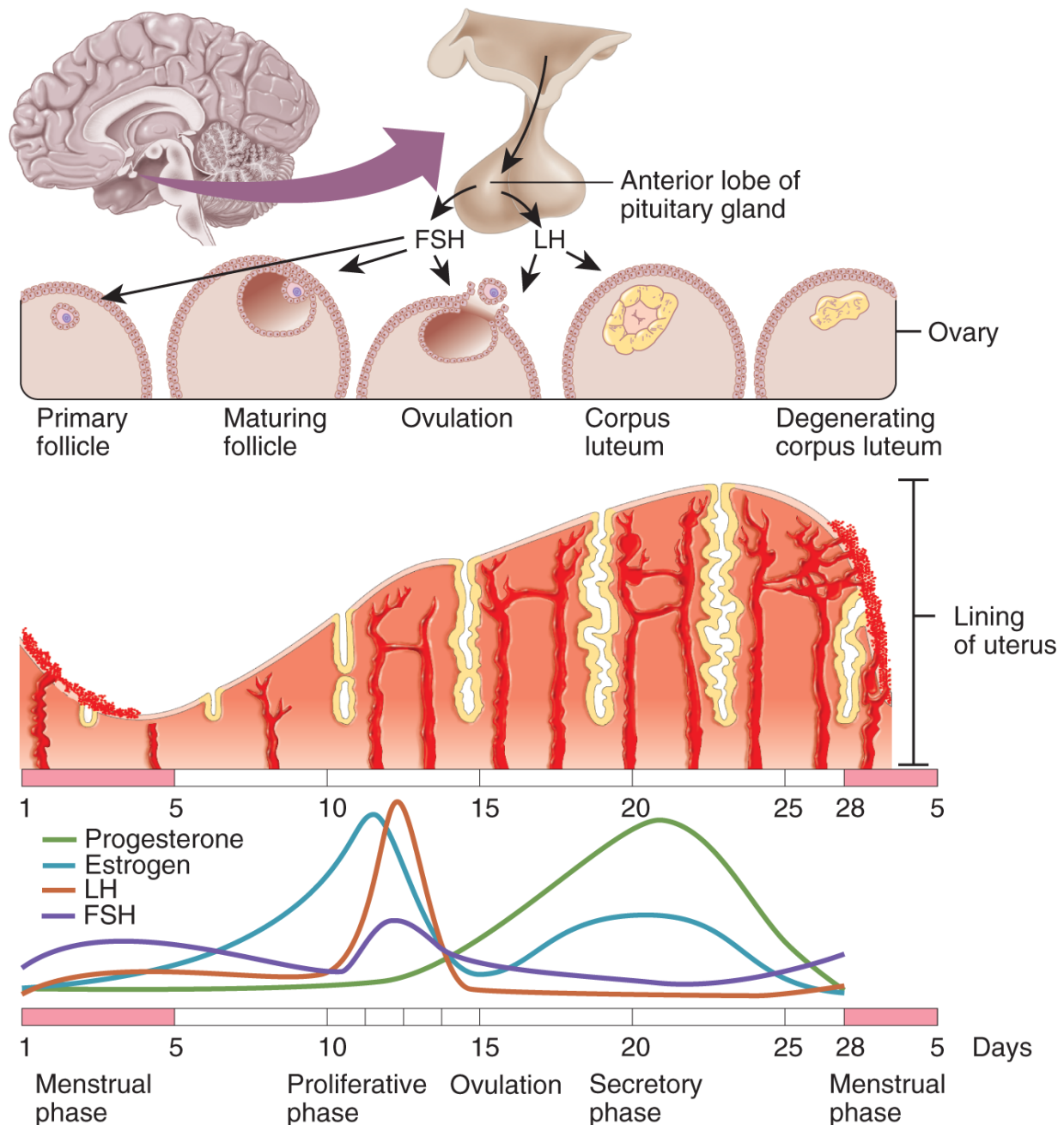


Figure 8.2 The Menstrual Cycle. Menstrual phase (days 1–5): The beginning of a cycle is marked by the first day of menstrual bleeding. Proliferative phase (days 6–14): Hormones from the hypothalamus trigger the release of follicle-stimulating hormone from the pituitary gland, which circulates through the blood to the ovaries and stimulates the production of estrogen and the maturation of an egg. Estrogen stimulates the proliferation of the lining of the uterus and uterine blood vessels. Ovulation phase (days 14–15): The egg is released from the ovary. Secretory phase (days 16–25): Hormones from the hypothalamus trigger the release of luteinizing hormone (LH) from the pituitary gland, which circulates through the

blood to the ovaries and stimulates the production of progesterone from a structure called the corpus luteum. Progesterone stimulates the development of nutrient-producing glands in the lining of the uterus. Next menstrual phase: If pregnancy does not occur, hormone levels drop, the uterine lining breaks down, and menstruation ensues.

Description

The length and regularity of the menstrual cycle vary from woman to woman and from time to time in the same woman. Most women experience cycles of approximately 28 days, with cycle lengths between 24 and 35 days being the most common. Shorter and longer cycles are possible. Irregular cycles, in which the number of days between menstruations varies from cycle to cycle, can occur. Irregular cycles are common when females first begin to menstruate (called the *menarche*) and when they stop producing ova later in life (*perimenopause*).

Tenderness and kindness are not signs of weakness and despair, but manifestations of strength and resolutions.

—Kahlil Gibran



Home Pregnancy Testing

When a woman wants to know if she is pregnant, she can consult a healthcare provider or go to a family planning or public health clinic. Or she can administer a pregnancy test herself. Several home pregnancy-testing kits are available without prescription at low cost, and they are relatively easy to use. Virtually all chemical tests for pregnancy—those carried out in clinics and the self-test kind—analyze a woman's blood or urine for the hormone of pregnancy, *human chorionic gonadotropin*.

Home pregnancy tests are not 100% accurate. Rarely does a test indicate pregnancy when the woman is not pregnant (a *false positive*). A false-positive result is likely to be discovered when the woman seeks prenatal care thinking she is pregnant. A *false negative*, indicating that a woman is not pregnant when in fact she is, can occur because the test has been administered too early in the pregnancy or for other reasons. The

possibility of a false negative is reason to repeat a negative test result a week later. A false negative is a serious drawback of home pregnancy testing because the risks of complications in pregnancy and abortion rise the longer a pregnant woman waits to obtain professional care.

In spite of the possibility of inaccuracy, many physicians and family-planning consultants believe home pregnancy testing to be useful. It enables women to take a more active part in their own health care, and it may help women who “would rather not think about it” confront the possibility that they are pregnant. When buying a home pregnancy test kit on the Internet, avoid products that claim to test for more than one thing such as HIV infection. Also avoid products made outside the United States (for more, see National Library of Medicine, <https://medlineplus.gov/lab-tests/pregnancy-test/>).

Some women experience unpleasant symptoms as the time of menstruation approaches and during the first days of menstrual flow. These symptoms can include abdominal pain (cramps), headache, backache, fatigue, feeling bloated, breast tenderness, depression, irritability, unusual aggressive feelings, and social withdrawal. With the onset of menstruation, the symptoms generally dissipate. (For more information, see the National Library of Medicine, <https://medlineplus.gov/premenstrualsyndrome.html>).

Methods for Preventing Unintended Pregnancy

A healthy, fertile couple having sexual intercourse about twice a week without trying to prevent pregnancy has an 85% chance of getting pregnant within 12 months. About 10% of couples are biologically incapable of getting pregnant. Nearly half of the 6.5 million U.S. pregnancies each year are unintended. About half of those pregnancies occurred because a pregnancy prevention method failed or was used improperly. Approximately 50% of American women ages 15 to 44 have experienced at least one unintended pregnancy. Because unintended pregnancy can be a life-changing experience with stressful outcomes, it behooves sexually active individuals to be mindful and capable of preventing that which is not desired.



Vaginal Health

The vagina possesses a unique physiology that is maintained by secretions that continually emanate from the vaginal walls. These secretions help regulate the growth of microorganisms that normally inhabit the vagina, and they also help to cleanse the vagina. Because the vagina is a self-cleansing organ, rarely is it necessary to employ any extraordinary cleansing measures such as douching. Douching often merely upsets the natural chemical balance of the vagina and increases the risk of developing vaginal inflammation called **vulvovaginitis** or *vaginitis*. Symptoms of vulvovaginitis include irritation or itching, redness or swelling of the vagina and vulva, unusual discharge, discomfort or a burning sensation when urinating, and, sometimes, a disagreeable odor. Vulvovaginitis is commonly referred to as a “yeast infection.” (For more information, see the National Library of Medicine, <https://medlineplus.gov/ency/article/000897.htm>).

Many factors increase susceptibility to vulvovaginitis, including the use of antibiotics, emotional stress, a diet high in carbohydrates, hormonal changes caused by pregnancy or birth control pills, chemical irritants such as vaginal sprays and spermicidal products, intercourse without adequate lubrication, and heat and moisture retained by nylon underwear and pantyhose.

Choosing a method to prevent unintended pregnancy requires weighing the benefits and drawbacks of each method and selecting one or more that both partners are comfortable *using properly each time sexual activity takes place*. Even the most technologically perfect method can fail when it is not used properly and consistently.

The effectiveness of a pregnancy prevention method is estimated in terms of its **failure rate**, which is the percentage of women who are likely to become pregnant during the first year of using that method. The **lowest user failure rate** estimates how well a method performs when used as intended and consistently. The **typical user failure rate** estimates how well a method performs when all of the errors and problems that people typically encounter with a method are taken into account. The effectiveness of common methods is given in **Table 8.4** and summarized below.

TABLE 8.4 Effectiveness Rates of Common Methods for Preventing Pregnancy

Method	Typical Use Failure Rate (%)	Lowest Observed Failure Rate (%)
No method (chance)	85	85
Withdrawal	22	4
Combination birth control pill	9	0.3
Contraceptive patch	9	0.3
Vaginal ring	9	0.3
Hormonal injection	3	0.3
Progestin-only pill	6	0.5

Method	Typical Use Failure Rate (%)	Lowest Observed Failure Rate (%)
Hormonal implants	0.05	0.05
Copper-T IUD	0.8	0.6
Hormonal IUD	0.2	0.2
Male latex condom	18	2
Female latex condom	21	5
Diaphragm	12	6
Sponge		
No prior births	12	24
Prior births	9	20
Spermicides	28	18
Fertility awareness	24	3–5
Tubal ligation	0.5	0.05
Vasectomy	0.15	0.1

Data are percentage of women becoming pregnant using a method for 1 year. *Typical use failure rate* means the method was not always used correctly. *Lowest observed failure rate* means the method was nearly always used correctly and with every act of sexual intercourse.

Data from Trussell, J. (2011). Contraceptive failure in the United States. *Contraception*, 83, 397–404.

Ineffective Methods: Not Recommended

- *No method* has an 85% typical failure rate.
- *Vaginal douching (cleansing) soon afterwards*, which is rinsing the vagina with fluid (water, diluted vinegar, commercial

douches) after sexual intercourse, is ineffective because thousands of ejaculated sperm move through the cervix and enter the uterus within a few seconds. There isn't time to flush sperm from the vagina before a significant number enter the uterus. Furthermore, the force from the spray of the douche might propel sperm into the uterus, aiding conception rather than preventing it.

Minimally Effective Methods (17%-23% Typical Failure Rate)

- *Penile withdrawal* (“pulling out”), also called *coitus interruptus*, requires the man to withdraw his penis from the vagina before ejaculation. Effectiveness is low because many men cannot exercise sufficient control to remove the penis in time. Also, semen deposited on the woman's genitals or abdomen, or on clothes or bed linen, can enter the vagina by contact with the vulva. Withdrawal has the added disadvantage of potentially diminishing a couple's sexual pleasure. When the partners are focused on whether the man will withdraw in time, neither is free to experience fully the pleasure of sexual interaction.
- **Fertility awareness methods**—also called *natural family planning*, *rhythm method*, *calendar method*, or *periodic abstinence*—attempt to determine the days in a woman's menstrual cycle when ovulation is most likely to occur or when ovulation has already taken place.

Knowing when ovulation is likely to occur or that it has already taken place tells a couple the days in the menstrual cycle *not* to have unprotected sexual intercourse—the **unsafe days**. On unsafe days, a couple should use an alternative method to prevent pregnancy, to

interact sexually without intercourse, or abstain from sexual contact altogether.

The days in the menstrual cycle when a woman is least likely to be fertile are called the **safe days**. Even on the safe days, however, fertilization is possible because of natural variations in a woman's reproductive processes. Therefore, safe days are really "relatively safe days."



Five Ways to Practice Fertility Awareness

1. *Calendar method*: <https://www.womenshealth.gov/pregnancy/you-get-pregnant/trying-conceive>
2. *Cervical mucus method*: <https://www.womenshealth.gov/pregnancy/you-get-pregnant/trying-conceive>
3. *Temperature method*: <https://www.womenshealth.gov/pregnancy/you-get-pregnant/trying-conceive>
4. *Symptothermal method*: combination of temperature and mucus methods
5. *Ovulation prediction*: <https://www.fda.gov/medical-devices/home-use-tests/ovulation-urine-test>

Fertility-awareness methods offer the advantages of being safe and inexpensive, and religious convictions make them the only acceptable pregnancy prevention methods for many. Failures occur because people do not keep careful records, find the intervals of abstinence during the unsafe days too long, or find having to plan sex only for the safe days a hindrance to spontaneous lovemaking.

Barrier methods of contraception block the movement of sperm in the female reproductive tract or bring sperm into contact with a sperm-killing chemical (**spermicide**). There are six common barrier methods:

1. *Male condom*: <https://www.cdc.gov/condomeffectiveness/male-condom-use.html> (see the Health Tip box "Condom Sense")

2. *Female condom*:
<https://www.cdc.gov/condomeffectiveness/Female-condom-use.html>
3. *Diaphragm*:
<https://www.nichd.nih.gov/health/topics/contraception/conditioninfo/types>
4. *Cervical cap*:
<https://www.nichd.nih.gov/health/topics/contraception/conditioninfo/types>
5. *Contraceptive sponge*:
<https://www.nichd.nih.gov/health/topics/contraception/conditioninfo/types>
6. *Spermicidal contraceptives (foams, gels, and creams)*:
<https://www.nichd.nih.gov/health/topics/contraception/conditioninfo/types>

Highly Effective Methods (7–10% Typical Failure Rate)

- **Hormonal contraceptives** are used by millions of American women and hundreds of millions of women worldwide because of their convenience, low cost, reversibility, tolerable side effects, and effectiveness.

Two forms of hormonal contraception are available: combination estrogen–progestin and progestin only. The ingredients in hormonal contraceptives are chemical variants of a woman's natural hormones, estrogen and progesterone.

Combined hormonal contraceptives include the

- *birth control pill* (monthly or extended),
 - *skin patch* (“patch”), and
 - *vaginal ring*
- (<https://www.cdc.gov/reproductivehealth/contraception/mmwr/sp>)

[r/combined.html](#))

Progestin-only methods include the

- *minipill*
(<https://www.cdc.gov/reproductivehealth/contraception/mmwr/sp/r/progestin.html>),
- *injectables* (“the shot”)
(<https://www.cdc.gov/reproductivehealth/contraception/mmwr/sp/r/injectables.html>), and
- *implants*
(<https://www.cdc.gov/reproductivehealth/contraception/mmwr/sp/r/implants.html>).



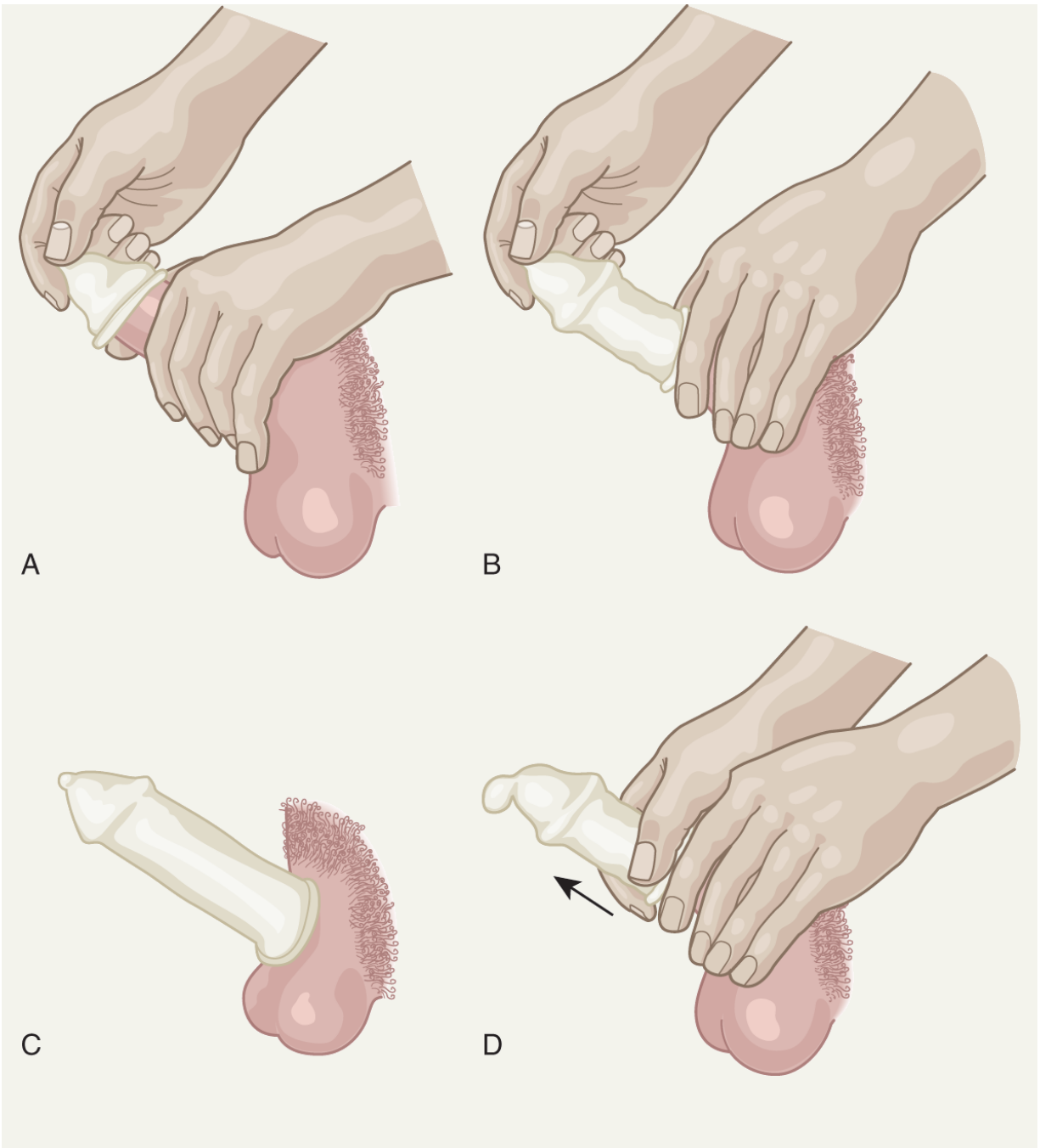
Condom Sense

Among **condoms**, latex condoms, used properly and every time, can be effective at preventing pregnancy. They also are effective at preventing sexually transmitted diseases (STDs). Natural or skin condoms are somewhat effective as contraceptives but are too porous to block the transmission of infectious agents. The FDA tests both domestic and international condoms for cracks and other defects in the rubber, leaks, and resistance to breakage. Tested and approved European condoms carry the CE Mark; in the United Kingdom, approval is indicated with the Kitemark. Elsewhere in the world, condoms are also ISO approved.

Putting on a Male Condom

- Use a fresh condom to lessen the possibility of leakage or breakage. Condoms that have been in a wallet, purse, drawer, or auto glove compartment may have been weakened by heat. Store condoms in a cool, dry place. Don't use a condom past its expiration date.
- Take the condom out of its package carefully so as not to damage it (no teeth, no fingernails). If there are holes or breaks, or if it's sticky or brittle, toss it out and use another.

- Put the condom on the erect penis before intercourse begins (see figure). Interrupting intercourse to put on a condom increases the chances of pregnancy and STD transmission because the male might not be able to control ejaculation.
- Unroll the condom onto the erect penis (pull back the foreskin). Leave about ½ inch at the tip to catch semen. Some condoms have specially designed (reservoir) tips for semen collection. The tip of the condom should be pressed free of air to prevent breakage after ejaculation.
- Do not use Vaseline or mineral oil as a lubricant. They will destroy the latex. If a lubricant is desired, use a water-based lubricant such as K-Y Jelly or Astroglide.
- After ejaculation, withdraw the penis before it becomes soft. Otherwise, the condom might slip off. When removing the penis, hold the condom on the back of the penis to be sure it does not slip off.
- Check the condom for holes or breaks. If any appear, spermicidal foam or jelly should be put into the vagina immediately, and possible emergency contraception (the so-called morning-after pill) should be sought.
- Condoms should be used only once and then discarded.



Unpleasant side effects that are associated with the use of hormonal contraceptives—many of which lessen or disappear after a few cycles—include nausea, breast tenderness, increased breast size, cyclic fluid retention, headaches, increased appetite or weight gain, depression, fatigue, decreased sex drive, acne or oily skin, and loss of interest in sex. Some beneficial side effects include

diminution or disappearance of menstrual cramps, a reduction in the number of bleeding days and blood loss, the ability to regulate the timing of the menstrual cycle, which can be important to travelers and athletes, lower risk of pelvic inflammatory disease, benign (noncancerous) breast disease, ovarian cysts, ectopic pregnancy, and iron-deficiency anemia.

Combination hormonal contraceptives do not increase the likelihood of developing breast cancer. However, users of this method who are older than 35 years of age and who smoke cigarettes are at risk for fatal blood clots and should stop smoking. High blood pressure, diabetes, and other health problems may make hormonal contraception unsafe. Experiencing severe abdominal pain, severe chest pain, severe headaches, unusual eye problems (blurry vision, “flashing lights,” or temporary blindness), or severe thigh pain is reason to consult a physician or health clinic immediately.



If You Missed Taking Your Hormonal Contraceptive

Being late or not taking a hormonal contraceptive can increase the risk of pregnancy. No matter what type of oral contraceptive you take, if you take it late or miss taking it:

1. contact your healthcare provider to ask what to do,
2. check the patient package insert and the pill manufacturer’s website, or
3. use a backup birth control method (e.g., diaphragm; sponge plus condom) for the rest of that pill cycle.

General Rules for Late Pill Taking

- More than 12 hours late, take the “late” pill and use a condom for the next week.
- Between 12 to 24 hours late, take the “late” pill as soon as you remember and take the regular pill for that day at the scheduled time. Use condoms for the next week.

Combination Pills

- Take the missed pill as soon as you remember and take the next pill at the regular time, even if you take two pills in one day.

- If you miss any of pills 15 to 21, ask your doctor or pharmacist for special instructions. She or he may ask you to continue taking your pills but to start a new pack instead of taking the remaining pills.
- If you forget to take two or more pills, contact your healthcare provider for instructions. Depending on the type of pill, you may need to start a new pack or double up on pills for awhile.

Progestin-Only Pill

- Take the missed pill as soon as you remember, and take the next pill at the regular time, even if you take two pills in one day. Use a backup method for the next 2 days.

Contraceptive Patch

- The patch contains 2 days of extra hormone. If left on for more than 9 days, use a backup method for the remainder of the cycle.

Contraceptive Ring

- The ring contains a week's worth of extra hormone. Women should check the ring periodically to be sure it is in place and removed when required.

In North America, combination hormonal contraception is the most popular reversible method of preventing pregnancy, accounting for nearly 25% of contraceptive use among all women who contracept and about 40% of women under 30 years old who contracept. Among North American college students, hormonal contraception is the method of choice for preventing unintended pregnancy, accounting for 66% of college contraceptors.

Extremely Effective, Failure Rate Less Than 1%

- The **intrauterine device (IUD)** is a small plastic object that is placed inside the cavity of the uterus to prevent pregnancy by killing or weakening sperm, altering the timing of the ovum's or embryo's movement through the fallopian tube, or inhibiting implantation of the embryo in the uterine lining. An IUD remains in place for as long as a woman desires, even for months or years. An IUD has a short string that hangs into the vagina

where it cannot be seen but can be felt to ensure proper placement. The string also aids removal.

IUDs available in the United States are flexible plastic devices shaped like a “T.” One type is impregnated with hormone (progesterone or a synthetic progestin). Another type is wrapped with fine copper wire that slowly dissolves and releases copper ions. Both the hormone and copper augment an IUD’s effectiveness by slowing sperm migration in the woman and preventing implantation of an embryo. Some IUD users experience heavier menstrual flow or menstrual cramps. IUD use is associated with an increased risk of pelvic inflammatory disease, uterine perforations, and ectopic pregnancy.

- An injectable **hormonal implant** (“*the shot*,” trade name Depo-Provera) involves injecting a 3-month supply of a synthetic progestin hormone, which is released into the body at a steady rate. At the end of the 12 weeks, a replacement injection or another contraceptive must be obtained. To get pregnant, a woman stops using the method.
- **Surgical sterilization** makes a person virtually permanently unable to have children with no effect on the ability to engage in or enjoy sex. (The surgery fails on rare occasions and an unintended pregnancy can result). Surgical sterilization applies to both males and females who are certain that they do not want children, or, as is more often the case, no more children. Surgical reversal is sometimes possible. Female sterilization methods include **tubal ligation** and *hysterectomy* (removal of the uterus); **vasectomy** is the male sterilization procedure. (For more information on vasectomy, see

<https://medlineplus.gov/ency/article/002995.htm>; for tubal ligation, see <https://medlineplus.gov/tuballigation.html>.)

Emergency Contraception

Emergency contraception is designed to prevent pregnancy if fertilization *might* have occurred. Situations that warrant emergency contraception include having unprotected intercourse, misusing a contraceptive (e.g., forgetting to take birth control pills; a condom breaking or slipping off), and sexual assault. Emergency contraception is not intended to be a primary method to avoid unwanted pregnancy. As the name implies, it is intended for unanticipated, emergency situations. The two forms of emergency contraception are the following:

Hormonal emergency contraception consists of taking pills with the same kinds of artificial hormones that are in contraceptive pills. One type contains both an estrogen and a progestin. It is taken in two large doses 12 hours apart within 72 hours of unprotected intercourse. Another type is a progestin-only pill. One product contains levonorgestrel; it is called Plan B. This pill must be taken within 72 hours of unprotected intercourse. It is available without prescription to women over 18 and to younger women with a prescription. Another emergency contraceptive pill containing ulipristal called *ellaOne* can be taken up to 5 days after unprotected intercourse. These methods are highly effective, reducing the risk of pregnancy by 90%. Side effects can include nausea and vomiting and possible adverse effects of the hormones on the developing fetus should the method fail and the pregnancy continue. These forms of emergency contraception block ovulation and thus are not regarded as methods of abortion.

IUD emergency contraception involves inserting a Copper-T IUD up to 5 days after unprotected intercourse. This method is more effective than the hormonal methods, reducing the occurrence of pregnancy by more than 99% following unprotected intercourse.

Why People Do Not Prevent Unintended Pregnancies

Despite a presumed and sometimes stated desire not to become pregnant, approximately 5% percent of married couples and 15% of unmarried sexually active individuals do not take steps to prevent unintended pregnancy. About 40% of sexually active American college students do not use a method to prevent pregnancy regularly. Some reasons that people do not take steps to prevent pregnancy even if they do not want to become pregnant include the following:

- *Low motivation.* People who know that they want children “sometime in the future,” who have mixed feelings about preventing pregnancy, or who are indifferent about becoming pregnant are less motivated to use a method to prevent pregnancy.
- *Lack of knowledge.* Not knowing the facts about conception and how to prevent pregnancy can lead to a false perception of risk for becoming pregnant. For example, some people believe the myths that pregnancy is not possible if a woman has an orgasm, if she urinates after intercourse, or if she is having sexual intercourse for the first time. Sometimes a method to prevent pregnancy is believed to be more effective than it really is or it is used incorrectly. For example, some people erroneously believe that a woman is most fertile during the bleeding days of the menstrual cycle, and thus practice fertility awareness incorrectly. Some couples lose, misplace, or run out of their primary contraceptive and do not have a backup method available.

- *Negative attitudes about preventing pregnancy.* Some people believe that preventing pregnancy is immoral, a hassle, unromantic, or harmful. These beliefs may lead to avoiding medically prescribed and over-the-counter contraceptives.
- *Ambivalence about being sexual.* Some people are unable to “plan ahead” with respect to preventing pregnancy because they cannot admit to themselves and others that they are sexually active. Ambivalence among women may arise from the conflict of desiring sex yet fearing being labeled “easy” or “a slut” by planning for it. Negative attitudes about sex and guilt about being sexual inhibit both learning about preventing pregnancy methods and using them correctly.
- *Relationship issues.* Individuals in committed sexual relationships are better contraceptors than individuals who are not in such relationships. Involvement with a committed partner tends to improve attitudes about and cooperation with contraceptive practice and, if helpful, lessen guilt associated with being sexual. People in a committed relationship tend to have sexual intercourse more often and regularly, which gives the couple opportunities to talk about contraception and to become adept at using an effective method they prefer. Individuals with irregular sexual contact, either because of geographical separation or relationship problems, may have difficulties in establishing a contraception regime. In new or casual sexual relationships, not using an effective pregnancy prevention method at first intercourse is common.



Self-Care: Wise Speech

Words can hurt. A lot. And that pain can hang around in memory and color future interactions. Unless your motive is to harm and damage someone or a relationship, speak wisely in important and delicate situations by applying these guidelines:

- Think first. You want to be heard and understood, so speak when you are centered and in control (take some calming breaths as described in the Wellness Guide in Chapter 9) and when the other is most likely to be receptive to your communication.
- Be clear on your intentions. Aim to enhance, not reduce or tear down, the other or your relationship. No blaming.
- Even if you are hurt and angry, approach with good will and, as much as you are able, kindness and compassion.
- Let any anger subside. Take a time out (minutes, hours days) if you need to. If you feel hurt, practice self-compassion instead of lashing out harshly with disdain and dismissiveness.
- Be true to the truth by not overstating or taking things out of context. Return to the truth if the conversation goes off track to other topics or high emotions.
- Know when to stop. You are presenting a point of view; it is not a boxing match.
- Thank the other with sincere gratitude for giving you the chance to be heard.
- Evaluate. Did you present yourself in a way that would produce the best outcome?

At first, wise speech may feel uncomfortable because it is new and certainly not modeled in media and public discourse. Like anything else, you become good at what you practice, so keep these suggestions in mind when you talk about something important. Also, practice wise speech when you talk to yourself!

Data from Hanson, Rick (2020). Speak Wisely. <https://www.rickhanson.net/speak-wisely/>

Sharing the Responsibility for Preventing Pregnancy

The responsibility for preventing pregnancy has two components: (1) choosing a method, taking into account the nature of an individual's (or couple's) sexual activities, the frequency of intercourse, future plans regarding having children, and personal and religious values; and (2) using chosen methods consistently and correctly. Although it may seem logical that the responsibility for contraception rests with the partner for whose body a particular method is designed, in actuality sharing the responsibility for contraception improves contraceptive effectiveness, sexual experience, and relationships. With shared responsibility, partners are more likely to use their chosen methods properly, which makes contraception more effective; reduce the fear of pregnancy, which makes sex more enjoyable; and reduce resentment for shouldering all the responsibility for pregnancy prevention, which strengthens the relationship. Mutual decision-making in choosing and using a method leads to better couple communication.

Sharing the responsibility for contraception means talking about it, which some people find embarrassing or awkward. Talking about contraception implies that sex is going to take place, which may force an individual to face personal ambivalence about engaging in sex. Also, some people assume that talking about contraception will hinder sexual spontaneity, whereas the opposite is true. Once concerns about contraception (and STD prevention) are addressed, couples can feel freer to express themselves sexually. Furthermore, some partners who are sexual with each other intermittently or for the first time may not discuss contraception before sex because they fear "spoiling the mood."

The best time to discuss contraception is before sexual intercourse begins. A partner can say something like, "I would really like to make love (have sex) with you, and I want to be sure we're

protected.” That kind of introduction can be followed by a statement of preference and personal responsibility, such as, “I prefer to use condoms” or “I’m on the pill” or, using a question such as “What birth control method do you prefer?” or “What are we going to do about birth control?”

Because many contraceptives are designed for use in the female, a man who wants to prevent an unintended pregnancy may not discuss contraception, fearing embarrassment or appearing ignorant or unmanly. Many women, however, welcome a man’s discussion of contraception. Discussions of contraception enhance communication about other sexual matters, too, such as the role of sex in a relationship, likes and dislikes, and preventing sexually transmitted diseases.

Abortion

Abortion is the intentional, premature termination of pregnancy. It is one of the oldest and most widely practiced ways to prevent pregnancy. Chinese medical writings dating from 2700 BCE recommended abortion. A cross-cultural study found that all but one of 300 societies had used abortion to control the size of families. Currently in the United States, approximately 1.5 million abortions are performed annually. This number represents about one-fourth of all pregnancies and about one-half of all unintended pregnancies. Three safe, medically administered abortion methods include the following:

- **medication abortion** or *chemical* abortion to stop pregnancy prior to the 7th week and induce uterine contractions to remove the uterine contents,
- *vacuum or aspiration* abortion between the 6th and 14th weeks of pregnancy to remove the postfertilization contents of the uterus with a vacuum instrument, and
- *dilatation and evacuation* to remove uterine contents after the 15th week of pregnancy.

Aftereffects of Abortion

Because the decision to terminate a pregnancy voluntarily is rarely easy, most women are ambivalent about abortion, as are many men. A variety of studies on women's psychological responses to legal abortion suggest that the time between the confirmation of pregnancy and receiving an abortion is generally emotionally trying, with most women experiencing anxiety and some depression (Biggs, Upadhyay, McCulloch, & Foster, 2017). After the abortion, symptoms of anxiety or depression are less prevalent, although a woman may experience anger or disappointment. The predominant feeling of most women is relief that the abortion had been performed successfully. Several months after their abortion, some women resolve upsetting feelings about the abortion and some continue to be troubled by the experience or consider it too upsetting to think about.

Preventing Sexually Transmitted Diseases

It is with our passions, as it is with fire and water, they are good servants but bad masters.

—Aesop

Throughout the world, about 25 different diseases can be passed from person to person via sexual contact; 11 are common in North America (**Table 8.5**). The World Health Organization estimates that each year 500–600 million people in the world acquire a **sexually transmitted disease (STD)**, also referred to as a *sexually transmitted infection* (STI). In North America, the number of annual STD infections approximates 19 million, a rate second only to the common cold (**Figure 8.3**). About half of these infections occur in people younger than 25.

TABLE 8.5 Common Sexually Transmitted Diseases (STDs)

STD	Symptoms	Treatment
HIV/AIDS	Flulike symptoms followed by any of a number of diseases characteristic of immunodeficiency	New drugs may retard viral reproduction temporarily; opportunistic infections can be treated to some degree.
Chlamydia	Usually occur within 3 weeks: men have a discharge from the penis and painful urination; women may have a vaginal discharge but often are asymptomatic	Antibiotics

STD	Symptoms	Treatment
Genital warts	Usually occur within 1 to 3 months: small, dry growths on the genitals, anus, cervix, and possibly mouth	Podophyllin
Gonorrhea	Usually occur within 2 weeks: discharge from the penis, vagina, or anus; pain on urination or defecation or during sexual intercourse; pain and swelling in the pelvic region; genital and oral infections may be asymptomatic	Antibiotics
Hepatitis B	Low-grade fever, fatigue, headaches, loss of appetite, nausea, dark urine, jaundice	Rest, proper nutrition; vaccination for hepatitis B
Genital herpes	Usually occur within 2 weeks: painful blisters on infection site (genitals, anus, cervix); occasionally itching, painful urination, and fever	None; acyclovir relieves symptoms
Molluscum contagiosum	Smooth, rounded, shiny, whitish growths on the skin of the trunk and anogenital region	Surgical
Pubic lice	Usually occur within 5 weeks: intense itching in the genital region; lice may be visible in pubic hair; small white eggs may be visible on pubic hair	Gamma benzene hexachloride
Scabies	Tiny, itchy lesions caused by mites burrowing into the skin	Topical insecticides
Syphilis	Usually occur within 3 weeks: a chancre (painless sore) on the genitals, anus, or mouth; secondary stage, skin rash (if left untreated); tertiary stage includes diseases of several body organs	Antibiotics
Trichomoniasis	Yellowish-green vaginal discharge with an unpleasant odor; vaginal itching; occasionally painful intercourse	Metronidazole

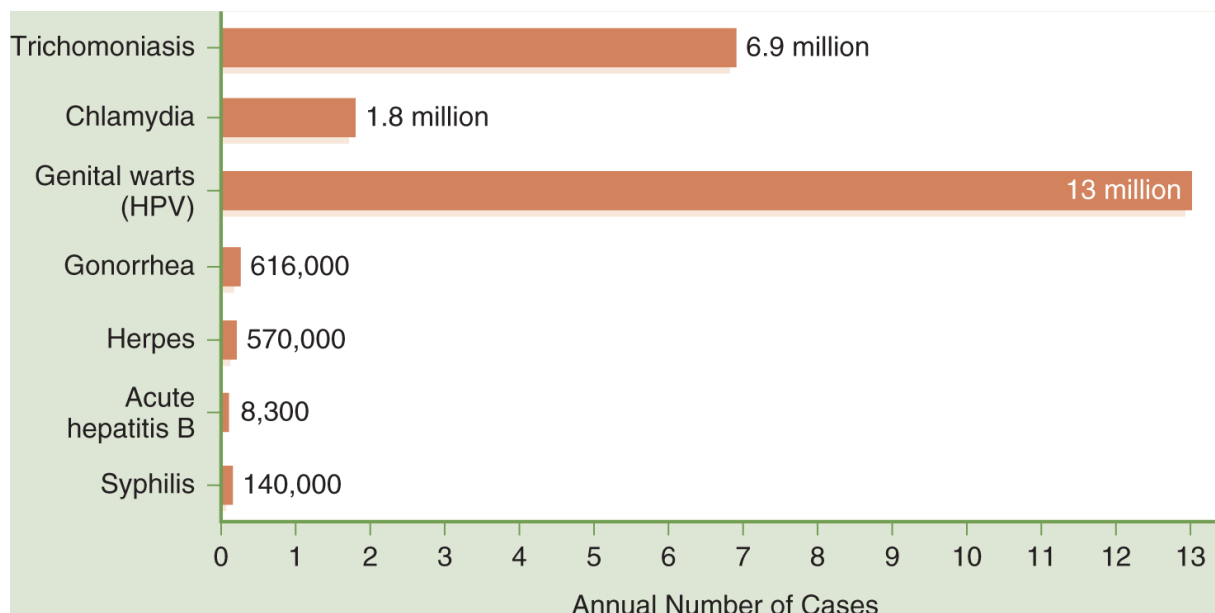


Figure 8.3 Estimated Yearly Number of STDs in the United States, 2020. HPV is the cause of cervical cancer and genital warts.

Data from U.S. Centers for Disease Control and Prevention
<https://www.cdc.gov/std/statistics/prevalence-2020-at-a-glance.htm>

Description

STDs have been afflicting humans for thousands of years. Ancient Chinese medical writings describe diseases of the genitalia that were probably syphilis. The ancient Egyptians described genital diseases that were probably gonorrhea. The Old Testament and Talmudic writings describe a condition called *ziba*, which was associated with the emission of fluid, referred to as *issue*, from the nonerect penis or the vagina. *Ziba* was probably gonorrhea, and *issue* was probably the discharge associated with the infection.

The Definition of STD/STI

An STD (or STI) is an infection that is transmitted usually by vaginal, oral, or anal sexual contact. Human STDs are caused by viruses, bacteria, protozoa, worms, and insects (**Table 8.6**).

TABLE 8.6 Agents That Cause Common STDs

	Infectious Agent	Disease
Bacteria	<i>Chlamydia trachomatis</i>	Chlamydia
	<i>Neisseria gonorrhoeae</i>	Gonorrhea
	<i>Treponema pallidum</i>	Syphilis
Viruses	Herpes simplex virus, types 1 and 2	Genital herpes
	Human papillomavirus	Anogenital warts Cervical cancer
	Human immunodeficiency virus (HIV)	AIDS
	Hepatitis virus B	Hepatitis
	<i>Molluscum contagiosum</i> virus	Molluscum contagiosum
Protozoa	<i>Trichomonas vaginalis</i>	Trichomoniasis (vaginitis)
Insects	<i>Phthirus pubis</i>	Lice (“crabs”)
	<i>Sarcoptes scabiei</i>	Mites (“scabies”)

STD-causing agents can enter the body (1) through breaks in the skin, (2) through the wet surface layers, called *mucous membranes*, of the body’s orifices—nose, mouth, penis, vagina, urethra, and anus—and (3) the blood, either by injection or during sexual activity by means of tiny microscopic abrasions on the penis, in the vagina, or mouth. Once inside the body, STD-causing agents reproduce, their population increases, and illness ensues.

In general, STDs are not transferred by animals, air, water, or contact with doorknobs, toilet seats, and other inanimate objects. In the case of insects, however, contact with any surface, including skin, on which the organisms, their larvae, or eggs might be present may cause an infection.

STD Risk Factors

Several factors increase the risk of contracting an STD. These are listed below. Being aware of the factors can help decrease the risk of acquiring an STD and also support community-wide STD prevention.

- *Multiple sexual partners.* Many individuals have several sexual partners in their lifetime because they become sexually active in late adolescence and may not marry until their mid- to late 20s or 30s. About 20% of unmarried adults have more than one sex partner in a year. Also, some people in a supposedly sexually exclusive relationship have sex with other individuals, generally without the primary partner's knowledge. Individuals who know that their partners have sexual relations with others have lower rates of STDs than individuals who do not know.
- *False sense of safety.* Using hormonal contraceptives may reduce the use of condoms as people equate preventing pregnancy with preventing STDs. Also, the availability of anti-STD medications such as antibiotics creates the false assumption that all STDs are curable (some such as herpes are not), which facilitates STD-risky behavior.
- *Absence of signs and symptoms.* Some STDs have mild or no symptoms, so an infection can worsen and unknowingly be passed to others. Among U.S. young adults ages 18 to 26, nearly 5% are infected with chlamydia and do not know it because of a lack of symptoms.
- *Untreated conditions.* Some individuals do not know the signs and symptoms of STDs, may not have access to medical care,

or may not comply with treatment regimens. Each factor contributes to an infected individual remaining contagious.

- *Impaired judgment.* Drug- and alcohol-impaired individuals are less likely to use condoms and may have sex with people they do not know, thus putting them at risk for contracting an STD. Increased alcohol taxes and increases in the legal drinking age are associated with decreased rates of gonorrhea, which suggests that alcohol consumption contributes to acquiring this infection, probably via having unprotected sex with unfamiliar partners.
- *Lack of immunity.* Some STD-causing organisms (for example, the **human immunodeficiency virus (HIV)**, herpes, gonorrhea, and chlamydia, can escape the body's immune defenses, causing individuals to remain infected and transmit the infection.
- *Body piercing.* Wounds from piercing give infectious organisms direct access to the bloodstream. Nipple, tongue, and lip jewelry may increase the risk of infections from oral contact. People who have had their bodies pierced should follow aftercare instructions faithfully to prevent infection. They should refrain from sexual contact in the pierced region until the hole is completely healed, which may take 3–6 months.
- *Value judgments.* Negative and moralistic attitudes about STDs prevent people from getting tested, contacting partners after a positive diagnosis, and talking to new partners about previous infections.
- *Denial.* “It can’t happen to me,” “He’s too nice to have an STD,” “She’s too good looking to have an STD,” and “The campus

community is safe” are fictions.



Talking About Possible STD Exposure with a

Sexual Partner

Verbally addressing one's possible exposure to STDs can be difficult (especially with a new partner) because of the fear of being rejected, offending the partner, or spoiling an erotic mood. Disclosing one's discomfort about talking about sexual interaction is one way to relieve anxiety about it. A conversation could begin with one partner saying, "There's something I want us to talk about and I feel sort of uncomfortable about it, but I think it's important to both of us, so here goes." After that introduction, the individual can offer information about him- or herself by saying something like, "We don't know each other very well; I'm concerned about sexual diseases. I want you to know this about me." That is followed by offering all of the information that he or she would like to be told. After hearing the disclosure, the other person is likely to respond in kind. And if more information is desired, one could say something like, "Thanks for telling me all of that. I'd feel more comfortable if I knew a little more about . . ." whatever it is.

What if the other person gets offended or won't talk about this subject? Or what if the other person can't be trusted? If partners cannot carry on a discussion about something as serious as STDs, postponing sexual interaction until the relationship has progressed to a greater level of trust is prudent. Potential sexual partners should keep in mind that being under the influence of alcohol or other drugs can affect one's judgment in making decisions about what is safe and what is not safe.

Preventing STDs

Vaccines to prevent hepatitis B and human papillomavirus (HPV) are available. Without vaccines, other STDs are prevented by consistent public health programs and services for STD education, prevention, and treatment. Infected individuals need to seek treatment and take responsibility for not infecting others. Individuals who practice "safer sex" reduce their risk of infection by abstaining from STD-risky sexual activity, knowing a sexual partner's sexual history, using latex condoms, being selective about sexual partners, postponing sexual interaction until a level of trust has been established, and disclosing to a new sexual partner one's prior exposure to an STD, if any. In

most instances, guidelines for safer sex are guidelines for sensible and better sex, whether one is concerned about STDs or not. Still, people do not always practice safer sex.

STD-Causing Protozoa and Bacteria

Trichomoniasis

Although not often regarded as sexually transmitted, vaginal infections caused by the protozoan *Trichomonas vaginalis* (**trichomoniasis**) are transmissible by sexual intercourse. Symptoms tend to occur in women (vaginal itching and a cheesy, odorous discharge from the vagina), but the organisms can survive in the urethra of the penis and under the penile foreskin. A man who harbors these organisms can infect other sexual partners or even reinfect the partner who transmitted the organisms to him.

Several million new cases of trichomonas are diagnosed in the United States each year. Clinically, a diagnosis is made by collecting fluid from the vagina and testing for the presence of trichomonas microorganisms. Medications are available to treat these infections successfully. An infected woman's male partner(s) should also undergo testing and treatment.

Bacterial Vaginosis

The vagina normally contains a variety of bacteria that support a healthy vaginal environment. However, overgrowth of certain types of bacteria (generally *Gardnerella vaginalis*) can cause an infection called **bacterial vaginosis (BV)**, which can be transmitted via sexual intercourse. Symptoms of BV include vaginal discharge, which may have a "fishy" smell, particularly after intercourse. Sometimes BV has no symptoms. BV is medically treated with metronidazole (Flagyl).

Chlamydia

Chlamydia is caused by the bacterium *Chlamydia trachomatis*, which specifically infects certain cells that line the mucous

membranes of the genitals, mouth, anus, rectum, the conjunctiva of the eyes, and occasionally the lungs. The chlamydia organisms bind to the surfaces of host cells and induce the host cells to engulf them. After gaining entrance to the cell, these organisms resist the host cell's defenses and "steal" from the host cell the biochemical materials required for their own survival and reproduction. The chlamydia organisms ultimately destroy the host cells.

Each year, approximately 2 million Americans are *reported* to have contracted chlamydia, which public health experts estimate represents only one-third of all cases that actually occur. In as many as half of all cases, chlamydia occurs simultaneously with gonorrhea. Besides adults, newborns are susceptible to chlamydia infection if their mothers are infected at the time of birth. The most common complications of chlamydia infection in newborns are conjunctivitis (eye infection) and pneumonia.

One reason why chlamydia infections are so prevalent is that 75% of infected women and 50% of infected men have extremely mild or no symptoms. Thus, infected individuals can unknowingly transmit the infection to new sex partners. When symptoms occur, they include pain on urination in both men and women (*dysuria*) and a whitish discharge from the penis or vagina. Symptoms generally appear within 7 to 21 days after infection.

Chlamydia can be treated successfully with *antibiotics*, drugs that kill bacteria. Left untreated, chlamydia organisms can multiply and cause inflammation and damage to the reproductive organs in both sexes. In men, untreated chlamydia can result in inflammation of the epididymis (*epididymitis*), which is characterized by pain, swelling, and tenderness in the scrotum, and sometimes a mild fever. Damage to the tissues in the epididymis can eventually lead to sterility. In women, untreated chlamydia infections can lead to infections of the cervix, uterus, fallopian tubes, and peritoneum. Often chlamydia infections of the female reproductive tract produce no symptoms until the infection is quite advanced. In these instances a woman may experience chronic pelvic pain, vaginal discharge, intermittent bleeding from the vagina, and pain during sexual intercourse (*dyspareunia*). Infection of the fallopian tubes can produce scar

tissue that damages the tubes' lining or partially or completely blocks the tube. These conditions may render a woman infertile. In the United States, about 10,000 cases of female infertility per year are the result of damage from chlamydia infection. Chlamydia infection can also increase the risk of an ectopic pregnancy.

Chlamydial infections induce an immune response in the host, but for unknown reasons infected individuals do not build an immunity to future chlamydia infections. This means that individuals can be reinfected after repeated exposure to the organisms.

Gonorrhea

Gonorrhea, also known as the “clap,” is caused by the bacterium *Neisseria gonorrhea*. Gonorrheal organisms specifically infect the mucous membranes of the body, most often the genitals, reproductive organs, mouth and throat, anus, and eye. *Neisseria* cannot survive on toilet seats, doorknobs, bed sheets, clothes, or towels. Transmission in adults almost always occurs by genital, oral, or anal sexual contact; infection of the eyes occurs by hand (usually through self-infection). Each year about 600,000 American adults are infected with gonorrhea.

Newborn babies exposed to gonorrheal organisms during vaginal birth may develop gonorrhea infection of the eyes. Most states require that antibiotics or a few drops of silver nitrate be put into the eyes of babies immediately after birth to kill gonorrhea bacteria and prevent possible blindness.

Although the bacteria causing them are quite different, the symptoms of gonorrhea and chlamydia infections are similar. Like chlamydia, many people infected with gonorrheal organisms do not develop symptoms, and thus their infections go unnoticed. If infections progress, men may develop epididymitis and women may develop infections of the uterus, fallopian tubes, and pelvic region. Untreated infections may cause sterility. When symptoms appear they include painful urination in both sexes and a yellowish discharge from the penis or vagina. Occasionally, there is pain in the

groin, testes, or lower abdomen. The first symptoms of gonorrhea usually appear within 7–10 days after exposure.

Gonorrhea can be successfully treated with antibiotics. However, new antibiotic-resistant strains of the gonorrhea organism are constantly appearing. In nearly half of all cases of gonorrhea, chlamydia also is present. Individuals undergoing examination for gonorrhea should also be tested for chlamydia.

Syphilis

Syphilis is caused by spiral-shaped bacteria called *Treponema pallidum*. These organisms are transmitted from person to person through microscopic breaks in the skin. The organisms can be transmitted through genital, oral, and anal contact as well as by direct transfer into the blood. Syphilis can also be transmitted from an infected mother to her fetus, perhaps as early as the 9th week of pregnancy.

The first noticeable sign of syphilis is a painless open sore called a *chancre* (pronounced SHAN-ker), which can appear any time between the 1st week and 3rd month after infection. If the infection is not treated within that time, the chancre will heal and the disease enters a “secondary stage” characterized by a skin rash, loss of hair, and the appearance of round, flat-topped growths on most areas of the body. Left untreated, the signs of the secondary stage also disappear, and the infection enters a symptomless (latency) period with no obvious signs, during which the syphilis organisms multiply in many other regions of the body, eventually damaging vital organs such as the heart or brain and causing severe illness or death. Syphilis can be treated successfully with antibiotics at any stage of the infection.

STD-Causing Viruses

Herpes Simplex Virus-2

Herpes simplex infections of the anogenital region are caused by either of two strains of *herpes simplex virus* (HSV), HSV-1 and HSV-2. HSV-1 is frequently associated with cold sores on the mouth (“fever blisters”), whereas HSV-2 is generally associated with lesions on the penis, vagina, vaginal labia, rectum, and the skin of the genital, pelvic, and anal regions. Each year between 500,000 and 1 million American adults acquire a genital herpes infection. As many as 40 million American adults have been and remain infected with HSV because the organism cannot be eliminated from the body.

A herpes lesion on the genitals usually appears within 2–20 days after exposure to HSV. The major symptoms of genital herpes infection are the presence of one or more blisters, which eventually break to become wet, painful sores that last about 2–3 weeks; fever; and occasionally pain in the lower abdomen. Eventually, these initial symptoms disappear, but the herpes virus remains dormant in certain of the body’s nerve cells, permitting periodic recurrences of symptoms called *flare-ups* at or near the initial infection sites. It is thought that stress, anxiety, poor nutrition, sunlight, and skin irritation can bring on recurrences. Flare-ups may be “telegraphed” by a tingling or itching in the genital region or pain in the buttocks or down the leg. Visible lesions may or may not appear, so people who anticipate or experience a flare-up should be cautious about transmitting HSV to a partner.

A herpes infection is extremely contagious when a sore is present. People with open lesions should not have skin contact with others until the lesions heal completely. Transmission is possible, although much less likely, even if no sore is present through the shedding of virus particles from the skin. Indeed, infections with HSV-2 often have no symptoms; nevertheless, infected persons are contagious.

Whereas genital herpes infections are most frequently caused by HSV-2 and oral herpes infections by HSV-1, both types can cause genital and oral infections with identical symptoms. Thus, people with oral herpes can transmit the infection to partners' genitals via oral sex. And they can transmit it to themselves through masturbation if they have touched a sore on their mouth.

Herpes viruses can infect the eyes, leading to impairment of vision and even blindness. If the virus is present in the birth canal, newborn babies can be infected, often resulting in brain damage and abnormal development. Two-thirds of babies with untreated herpes infections die. Pregnant women who have had herpes should tell their health providers of previous infections to prevent possible transmission of HSV to their newborn babies.

There is no cure for herpes. Infected individuals remain so for life. However, several drugs can minimize the duration and severity of the symptoms of an initial infection or a flare-up.

Human Papillomaviruses and Anogenital Warts

Human papillomaviruses (HPVs) are a group of more than 100 types of similar viruses, about 40 of which can be passed from person to person via sexual contact. About 20 million Americans are currently infected with HPV; about 6 million Americans become infected with HPV via sexual intercourse each year. Most HPV infections are symptomless and go away on their own. However, persistent infections with one or more of 10 types of HPV can cause cervical cancer in women. About 12,000 American women develop cervical cancer each year; about 4,000 American women die each year of the disease.

Some types of HPV may cause visible warts (*Condylomata acuminata*) on or around the genitals or anus within 3 months of contact with an infected person. Other types of HPV do not cause visible anogenital warts, although they infect the vagina, cervix, penis, and the mouth and larynx (from oral sex with an infected person). The types of HPV that cause visible warts on hands and feet are different from those that cause growths in the genital region.

Visible anogenital warts usually are raised or flat, single or multiple, small or large, sometimes cauliflower shaped, soft, moist, pink, or flesh-colored swellings. They can appear on the vulva, in or around the vagina or anus, on the cervix, and on the penis, scrotum, groin, or thigh. The warts are contagious. Anogenital warts can be removed by self-applied medications (imiquimod cream, podophyllin or podofilox solutions). Also, they can be removed by a healthcare provider. Clinician-applied treatments include applying 10–25% podophyllum resin, trichloroacetic acid, or bichloroacetic acid; physically excising the wart; and cryosurgery (freezing), electrocautery (burning), or exposure to laser. Treatments remove the warts but not HPV in cells, so warts can reappear after treatment. Without treatment, warts may disappear or they may grow more numerous or larger.

Many genital HPV infections do not cause visible warts or symptoms even though the virus lives in the skin or mucous membranes. A health practitioner can detect invisible infections in several ways: (1) applying vinegar (acetic acid) to suspected infected regions and looking for infected cells to whiten, (2) viewing the vagina and cervix with a magnifying instrument (colposcopy), (3) removing a small amount of tissue (biopsy) for analysis of HPV DNA, and (4) performing a Pap smear to look for abnormalities in cervical cells associated with HPV infection.

The types of HPV that infect the genital area are spread primarily through genital contact. Most HPV infections have no signs or symptoms, so most infected persons are unaware they are infected, yet they can transmit the virus to a sex partner. Rarely, a pregnant woman can pass HPV to her baby during vaginal delivery.

There is a vaccine against two types of HPV that cause about 70% of cervical cancers and two types of HPV that cause about 90% of genital warts. The vaccine is given in a series of three injections over a 6-month period. The vaccine is highly effective in preventing HPV infection in young women who have not yet been exposed to HPV. Many health professionals recommend that all young women be vaccinated against HPV before they reach the age at which they are likely to become sexually active.

Besides vaccination, infections with HPV may be prevented by avoiding sexual and other skin-to-skin contact with an infected person and using latex condoms.

Hepatitis B Virus

Hepatitis B is a disease of the liver caused by infection with **hepatitis B virus (HBV)**, one of several types of hepatitis viruses. HBV is transmitted most often sexually and by blood. About 150,000 sexually transmitted HBV infections occur in the United States each year; worldwide, the number is estimated to be about 300 million.

About 30% of infected persons infected with HBV do not have any symptoms. When they appear, symptoms include low-grade fever, fatigue, headache, loss of appetite, nausea, dark urine, and jaundice (yellowing of the white of the eyes and skin). The first symptoms, which are flulike, appear between 14 and 100 days after infection. Signs of liver disease appear later.

No specific therapy exists for HBV infection. Rest, proper nutrition, and avoidance of substances harmful to the liver (e.g., alcohol and drugs) are required for recovery, which may take many months. Long-term liver damage is possible, including cancer of the liver and death.

A vaccine against HBV is available and everyone is advised to be vaccinated, especially children, health workers, and others who are at high risk of exposure.

Acquired Immune Deficiency Syndrome (AIDS)

Acquired immune deficiency syndrome (AIDS) is caused by the *human immunodeficiency virus* (HIV). Infection by HIV causes a variety of diseases that result from the destruction of the body's immune system cells that are used to combat infections. Lack of a functional immune system makes a person susceptible to a variety of bacterial, viral, and fungal infections (called *opportunistic infections*) that a person with an intact immune system could readily ward off. Left untreated, HIV multiplies in immune system cells, the immune

system progressively weakens, and infected individuals eventually become sick and die.

The course of an HIV infection varies greatly; some individuals progress to full-blown AIDS and death within months of infection by HIV; others may have no symptoms for 10 years or more after the initial infection. During this symptomless period, the infected person is nevertheless contagious and can transmit HIV to others. The first signs of AIDS are usually mononucleosis-like symptoms (swollen lymph glands, fever, night sweats) and possibly headaches and impaired mental functioning. As the disease progresses, individuals often suffer weight loss, infections on the skin (*shingles*) or throat (*thrush*), lung infections, and certain kinds of cancer.

Among adults, HIV is mainly transmitted by blood, semen, or vaginal fluids of infected people. HIV can also be transmitted from mother to child during pregnancy, childbirth, and via breast milk. About 35 million people in the world currently are infected with HIV. About 25 million people have died from AIDS since the global AIDS epidemic began around 1980. In the United States, about 1 million persons currently are infected with HIV and more than 500,000 Americans have died of AIDS. In the United States, HIV infections most commonly occur in men and women between ages 20 and 60. The most common routes of HIV transmission are men having sex with men, injection drug use, and men and women having sex with infected other-sexed individuals. HIV/AIDS is not acquired from getting a blood test or donating blood. Because of careful donor screening and testing, acquiring HIV/AIDS from a blood transfusion in a hospital is highly unlikely.

There is no cure for HIV/AIDS. Treatment of the disease relies on (1) medically managing the opportunistic infections that result from immune suppression and (2) attempting to keep the HIV infection in check with anti-HIV drugs. Whereas anti-HIV drugs can be successful in reducing the levels of HIV in the body, they do not eliminate the viruses completely. Without continued use of the drugs, viral levels quickly rise again. Another drawback to anti-HIV drugs is that HIV can develop resistance to them, thus reducing their effectiveness. Finally, anti-HIV drug treatment can cost \$10,000 a

year or more per patient, which is too expensive for 90% of the HIV-infected people in the world. Ultimate prevention of AIDS depends on development of a vaccine that would prevent HIV infection—a medical advance that has eluded HIV/AIDS researchers thus far.

HIV Testing

When individuals first become infected with HIV, their immune systems are still intact and they produce copious infection-fighting proteins called *antibodies* that destroy HIV. Detecting anti-HIV antibodies is the basis of nearly all HIV/AIDS tests. Other HIV tests detect the genetic material in HIV particles, which is a more accurate measure of the level of infection (called the *viral load*).

Health officials do not advocate that everyone be tested for HIV. They do recommend, however, that individuals be tested routinely when they seek medical services or when they may have been exposed to HIV infection in any of the following ways:

- injecting drugs or steroids using equipment (needles, syringes, *works*) shared with others;
- having unprotected vaginal, anal, or oral sex with men who have sex with men, multiple partners, or anonymous partners;
- exchanging sex for drugs or money;
- having been diagnosed with or treated for hepatitis, tuberculosis, or a sexually transmitted disease;
- having had sex with someone whose history of sex partners or drug use is unknown to you;
- having sex with several partners; or
- having sex with someone while drunk.

HIV tests can detect antibodies to HIV within 2 to 8 weeks (the average is 25 days) after exposure to the virus. In some individuals, a test may not detect antibodies for 6 months or longer after exposure to HIV. If an initial HIV test was negative within the first 3

months after possible exposure, then repeat testing should be considered to establish the negative status with certainty.

Most commonly, a blood sample is used to detect HIV infection. Tests using saliva or urine are also available. Some tests require a few days for the results; other rapid HIV tests can give results in about 20 minutes. All positive HIV tests must be confirmed by another more definitive test (called the *western blot*). Results of this confirmatory test can take a few days to a few weeks.

HIV/AIDS testing requires pre- and posttest counseling by a health professional or trained HIV counselor. Pretest counseling involves explaining the testing procedure, confidentiality issues, HIV/AIDS prevention, and the significance and choices if the result is positive. Posttest counseling involves discussing what negative or positive results mean, possible need for retesting, treatment options if the test is positive, and additional HIV/AIDS education.

HIV tests can be obtained from physicians and from a variety of health agencies. Tests can be anonymous or confidential. In anonymous tests, individuals are identified only by a self-selected number or alias, so the true identity is never recorded. In confidential tests, one's name is part of the medical record, which is supposed to be confidential.

An at-home HIV-test kit has been approved by the U.S. Food and Drug Administration. The test procedure involves pricking a finger with a special device, placing drops of blood on a specially treated card, and then mailing the card to a licensed laboratory. Customers are given an identification number to use when phoning in for the results. Callers may speak to a counselor before taking the test, while waiting for the test result, and after the results are given. All individuals receiving a positive test result are provided referrals for a follow-up confirmatory test, as well as information about treatment and support services. Most HIV test kits sold over the Internet are unreliable. The U.S. Food and Drug Administration website offers updates on approved at-home HIV test kits: search for "FDA Facts About In-Home HIV Testing."

Molluscum Contagiosum

Molluscum contagiosum is caused by a virus of the same name. About 100,000 infections occur in the United States each year. The infection is characterized by the appearance of freckle-sized, rounded, shiny, whitish growths on the skin and trunk and anogenital region. Generally, there are no associated symptoms. The lesions may resolve spontaneously, but it is best to have them removed by a health professional; otherwise they may be transmitted to others or recur.

STD-Causing Insects

Pubic Lice

Pubic lice (*Phthirus pubis*), also known as “crabs,” are barely visible insects that live on hair shafts primarily in the genital–rectal region, and occasionally on hair in the armpits (axilla), the beard, and eyelashes. The organisms’ claws are specifically adapted for grasping hairs with the diameter of pubic and axillary hair, which differs in diameter from the shafts of scalp hair. Thus, pubic lice are not usually found on the head. (Scalp hair is the ecological niche for the head louse, *Pediculus humanus capitis*.)

Lice feed on blood taken from tiny blood vessels in the skin, which they pierce with their mouth parts. Some people are sensitive to the bites and may experience itching, which is often the main symptom of infestation. The lice can also be seen; they look like small freckles. The eggs of lice are enclosed in small white pods (called *nits*) that attach to hair shafts. The presence of nits is also a sign of infestation.

Lice are transferred by body-to-body contact. They can also be transmitted via contact with objects on which lice eggs might have been laid, such as towels, bed linens, and clothes. An infestation of pubic lice can be eliminated by washing the pubic hair with liquids or shampoos containing agents that specifically kill lice (e.g., pyrethrins, piperonyl butoxide, and gamma benzene hydrochloride). All of an infected person’s clothes, towels, and bed linens should also be washed in hot water.

Scabies

Scabies is an infestation of certain regions of the skin by extremely small (invisible to the naked eye) mites, *Sarcoptes scabiei*. The mites burrow into the skin where they live and lay eggs. The tiny lesions produced by the mites often cause intense itching, which is

the major sign of a scabies infection. The mites produce tiny burrows across skin lines, which often go unnoticed. Occasionally, an infestation will produce small round nodules. The mites tend to live in the webs between the fingers, on the sides of fingers, and on the wrists, elbows, breasts, abdomen, penis, and buttocks. Rarely do mites live on the face, neck, upper back, palms and soles.

Scabies can be transmitted sexually and nonsexually. All that is required is sufficient personal contact. The itching and any physical signs of the mites often take several weeks to appear. Scabies can be treated and eliminated with topical agents that also kill mites and their eggs.

Critical Thinking

1. When choosing a method of contraception, a couple decided to base their decision on a method's lowest observed or theoretical failure rate. Explain why it would be better for them to use the typical use or actual failure rate.
2. Jason and Ilana were going to make a great couple. All of their friends thought so. But Jason was troubled. Although they agreed not to have sexual intercourse before marriage, as their intimacy deepened Ilana felt obliged to tell Jason of the genital herpes infection she acquired when she was a wild 15-year-old. "I'm not that person anymore," she said, "and it's under control. Still, you never get rid of it." Should Jason continue with this relationship? What factors should he consider in making his decision.
3. The monthly meeting of the Washington County School Board had never had so many attendees as the night of the vote on the new health curriculum for the county's middle schools. At issue was revising the module on sexual infections to include *how such* infections were actually transmitted. Some parents objected to including and discussion of STD and HIV/AIDS, arguing that doing so only makes the students curious about sex and drugs and encourages experimentation. A second group of parents while supporting a discussion of the causes and symptoms of the diseases, nevertheless objected to any discussion of behaviors involved in their transmission. They believed that the children ought to know about the biological aspects of the issue as a foundation for their own efforts at dissuading their children from any experimentation with unsafe sexual practices and drugs. A third group of parents argued that the only way to ensure prevention was to discuss the behaviors involved. They claimed that the children would not take the discussion seriously unless all aspects of the issue were covered, and hence they would be tempted either to disregard the information or to become curious

about what was not covered and put themselves at risk. If you were one of the school board members, how would you vote and how would you justify your vote to parents?

CHAPTER SUMMARY AND HIGHLIGHTS

A wide variety of methods to prevent pregnancy are available to people who want to have sexual intercourse but do not want to become pregnant. These methods include many kinds of hormonal contraceptives, male and female condoms, fertility-awareness methods, IUDs, spermicides, and sterilization methods. Sexual partners discussing their preferences in pregnancy prevention can increase the possibility that a contraceptive method is used.

About half of all pregnancies in the United States are classified as unintended or unplanned, and the majority occur among young couples who are not prepared for a pregnancy because of age, life circumstances, finances, or emotional maturity. These unintended pregnancies can be terminated by choice with medical assistance.

Organisms that cause sexually transmitted diseases include viruses, bacteria, protozoa, and insects. The most frequently diagnosed STDs are trichomoniasis, chlamydia, gonorrhea, syphilis, herpes, genital warts, pubic lice, and HIV/AIDS. To acquire one of these diseases requires direct physical contact with an infected person. Although some STDs can be cured with medications or prevented by vaccination, the key to controlling all STDs is prevention. Male condoms are the best defense against STDs; avoiding risky sexual encounters is another. If you think that you have a sexually transmitted disease, seek medical help as soon as possible. Do not engage in sexual activities until you are well and no longer infectious.

HIGHLIGHTS

- A variety of safe, reliable, and effective pregnancy prevention methods are available. These include combination and progestin-only hormonal contraception, barrier methods

(condom, diaphragm, cervical cap, and spermicides), fertility awareness methods, the IUD, and sterilization.

- A contraceptive's effectiveness is measured in terms of lowest observed and typical use failure rates.
- Although most pregnancy prevention methods are designed for use in the woman's body, both partners share the responsibility for fertility control. Communication and cooperation are keys to shared responsibility.
- People who say they do not want to have a baby, yet do not practice fertility control, tend to have low motivation, lack of knowledge of human reproduction and pregnancy prevention methods, negative attitudes toward preventing unintended pregnancy, or are in relationships that hinder preventing unintended pregnancy.
- Two abortion methods are available: medication and surgical
- Sexually transmitted diseases are infections passed from person to person by sexual contact.
- Millions of sexually transmitted infections occur each year in the United States.
- STDs are epidemic in the United States because people are uninformed about them and engage in high-risk behaviors, and because vaccines and cures (for several) are unavailable.
- The most common STDs in the United States are trichomoniasis, chlamydia, gonorrhea, syphilis, herpes, genital warts, pubic lice, and AIDS.
- Preventing STDs involves supporting public health efforts to inform the populace about STDs and their prevention and

treatment. It also requires individuals to practice safer sex and to comply with treatment when they are infected.

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KEY TERMS

fertilization:

the fusion of a male's sperm cell with a female's ovum to form a fertilized egg

fallopian tubes:

a pair of female, pelvic anatomical structures in which fertilization takes place

ovaries:

a pair of almond-shaped structures in the female pelvic cavity that produce ova (eggs) and sex hormones

cervix:

the opening in the lower part of the uterus that permits sperm to pass from the vagina to the uterus and a fetus to the outside at birth

menstruation:

sloughing of the lining of the uterus and associated small blood vessels

menstrual cycle:

near monthly production of fertilizable ova

vulvovaginitis:

vaginal irritation, often called a yeast infection

failure rate:

likelihood of becoming pregnant if using a birth control method for 1 year

lowest user failure rate:

how well a method performs when used both as intended and consistently

typical user failure rate:

estimates how well a method performs when all of the errors and problems typically encountered with a method are taken into account

fertility awareness methods:

methods of birth control in which a couple charts the cyclic signs of the woman's fertility and ovulation or uses basal body temperature, mucus changes, and other signs to determine fertile periods

unsafe days:

days in the menstrual cycle when fertilizable ova are most likely to be produced

safe days:

days in the menstrual month distant from when fertilizable ova are likely to be produced

condom:

a latex or polyurethane sheath worn over the penis (male condom) or inside the vagina (female condom); can be both a barrier method of contraception and act as a prophylactic against sexually transmitted diseases

spermicide:

a chemical that kills sperm; particularly foams, creams, gels, and suppositories used for contraception

hormonal contraceptives:

pills, a skin patch, a vaginal insert, and injections that contain two kinds of synthetic hormones that are chemically similar to a woman's natural ovarian hormones, estrogen and progesterone

intrauterine device (IUD):

a flexible, usually plastic, device inserted into the uterus to prevent pregnancy

hormonal implant:

1.5-inch hormone-containing plastic rod placed under the skin, where it remains for 3 years to prevent pregnancy

surgical sterilization:

rendering a person virtually unable to have children but with no effect on the ability to engage in or enjoy sex

tubal ligation:

a surgical procedure in women in which the fallopian tubes are cut, tied, or cauterized to prevent pregnancy; a form of sterilization

vasectomy:

a surgical procedure in men in which segments of the vas deferens are removed and the ends tied to prevent the passage of sperm

emergency contraception:

using contraceptive hormones or an IUD to interrupt a possible pregnancy

abortion:

the expulsion or extraction of the products of conception from the uterus before the embryo or fetus is capable of independent life; abortions may be spontaneous or induced

medication abortion:

nonsurgical abortion using specific medications to stop pregnancy

sexually transmitted disease (STD):

an infection or infestation caused by a biological agent (e.g., virus, bacterium, insect) that is transferred from person to person by sexual interaction

human immunodeficiency virus (HIV):

the virus that causes AIDS

trichomoniasis:

vaginal infection caused by the protozoan *Trichomonas vaginalis*

bacterial vaginosis (BV):

a vaginal infection, often caused by *Gardnerella vaginalis*

chlamydia:

a sexually transmitted bacterial infection of the genitals, anus, mouth, eyes, and occasionally the lungs

gonorrhea:

a sexually transmitted bacterial infection of the genitals, anus, mouth, and eyes

syphilis:

a sexually transmitted bacterial infection caused by the bacterium *Treponema pallidum*

herpes simplex:

a sexually transmitted viral infection of the genitals, anus, mouth, and eyes, characterized by the appearance of wet, open, painful sores at the site of the infection

human papilloma virus (HPV):

the causative cause of anogenital warts and occasionally cervical cancer

hepatitis B virus (HBV):

virus that causes disease of the liver

acquired immune deficiency syndrome (AIDS):

a syndrome of more than two dozen diseases caused by HIV

molluscum contagiosum:

a virus-caused STD

pubic lice:

insects that live on the hair shafts in the pelvic region

scabies:

an infestation of the skin by mites



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CHAPTER 9

Infections and Immunity



Health Tips

Getting Rid of Dust Mites May Help Allergies



Global Wellness

Prevent Sickness While Traveling



Wellness Guide

The Human Microbiome at Birth

Self-Care: The Calming Breath

My Vaccination Record

LEARNING OBJECTIVES

1. Define pathogen, communicable disease, vector, immunizations, immune system, antibodies, antigens, and autoimmune diseases.
2. Describe the human microbiome.
3. Identify and explain how infectious diseases are prevented and treated.
4. Discuss the importance of antibiotics with regard to bacterial infections and the implications of antibiotic-resistant strains of bacteria.
5. Discuss how vaccinations prevent infections.
6. Explain how antibodies battle infectious diseases.
7. Describe how unwanted activities of the immune system cause allergies.
8. Discuss organ transplants, blood transfusions, and the Rh factor.

Throughout human history, millions upon millions of people have died from infections of various kinds. An **infection** is the entry, survival, and reproduction of nonself-organisms in one's body ("the host"), principally by microorganisms that are not visible to the naked eye (thus, *micro*), but also visible invaders such as insects and worms. Infectious organisms are often referred to as *parasites*, which means they survive and reproduce by deriving nutrients and other benefits at the host's expense. If the actions of a parasite cause an **infectious disease**, it is considered a **pathogen**. A remarkable variety of organisms, including viruses, bacteria, yeast, and fungi, can infect the human body (**Figure 9.1**).

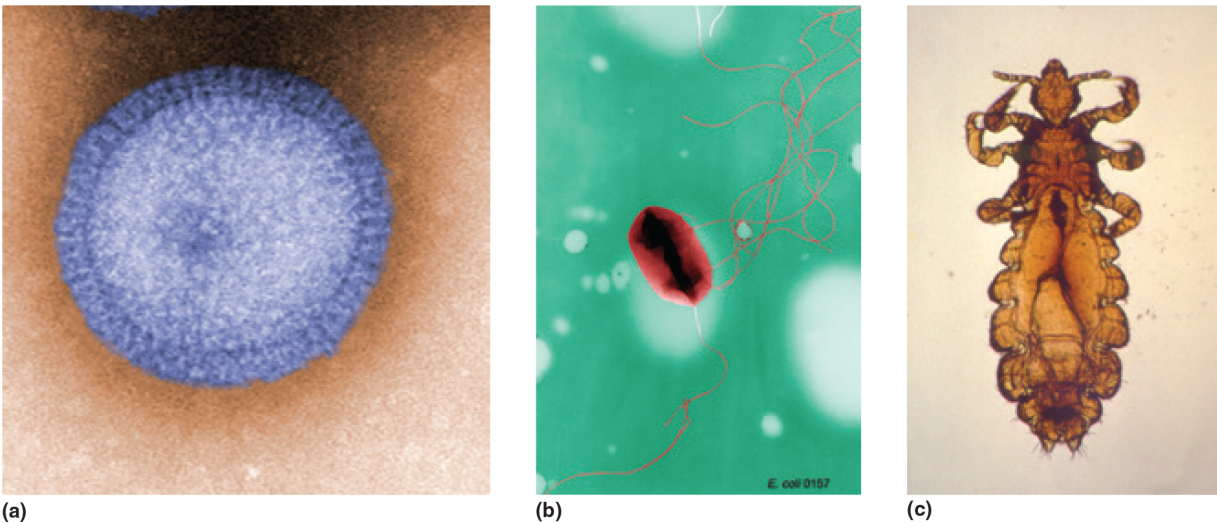


Figure 9.1 Infectious Organisms. Electron micrographs of (a) an influenza virus that causes flu, (b) Salmonella bacteria that cause food poisoning, and (c) head louse. Both the “flu” virus and the bacteria are easily passed from person to person and cause widespread epidemics.

(a) Courtesy of Dr. F.A. Murphy/CDC; (b) Courtesy of Elizabeth H. White, M.S./CDC; (c) Courtesy of CDC/ Dr. Dennis Juranek.

Since early in the 20th century, improvements in sanitation, personal hygiene, nutrition, immunizations, antimicrobial drugs, infectious disease medical care, and public health measures to prevent infections have greatly reduced the amount of sickness and the number of deaths from infectious disease such as polio, smallpox, and measles. However, as we have learned from the COVID-19 pandemic, widespread, deadly infectious diseases, such as tuberculosis, malaria, and influenza are still part of human existence. Indeed, prior to the COVID-19 pandemic, in many regions of the world, millions of people died each year from infectious diseases ([Table 9.1](#)), an occurrence likely to continue for some time to come despite efforts at infection control (Daszak, Keusch, Phelan, Johnson, & Osterholm, 2021).

TABLE 9.1 | **Estimated Annual Deaths Worldwide from Infectious Diseases**

Infectious Disease	Worldwide Annual Deaths
Acute respiratory infections	3.2 million
Diarrheal diseases	1.4 million
Tuberculosis	1.4 million
HIV/AIDS	1.1 million
Malaria	439,000
Meningitis	315,000
Hepatitis (A, B, C, D)	145,000
Pertussis (whooping cough)	273,000
Leishmaniasis	140,000

Data from World Health Organization. (2016). Disease burden and mortality estimates. Retrieved from http://www.who.int/healthinfo/global_burden_disease/estimates/en/index1.html

Infecting organisms can enter a host's body by direct contact with a source of those organisms, such as contaminated food or water, body fluids from an infected person, or from animals. Some infectious agents are transmitted from source to host through the air. Airborne transmission is generally faster and more efficient than direct contact, which is the reason we were urged to don face coverings and socially distance during the COVID-19 pandemic. An infection passed from person to person is called a **communicable disease**. Colds, measles, chicken pox, the **human immunodeficiency virus (HIV)** and the resulting **acquired immune deficiency syndrome (AIDS)**, and gonorrhea are all communicable diseases.

Besides person-to-person contact, infectious organisms can be transferred to people from animals, especially insects. In these instances, the animal or insect is said to be the **vector**, or carrier, of

the disease-causing microorganism. For example, malaria is usually caused by a microscopic protozoan called *Plasmodium falciparum*. When a person with malaria is bitten by a mosquito, malaria parasites enter the mosquito's saliva and can be transferred into another person by a bite from the same mosquito. Thus, mosquitoes are the vectors for malaria. (Only a few species of mosquitoes carry the malaria parasite.) Rabies, a disease of the nervous system caused by the rabies virus, is present in infected dogs, cats, bats, skunks, and other animals. Rabies virus can be transmitted to a human through the saliva of the rabid animal, making the animal a vector for the disease.

Even the healthiest person can contract an infectious disease. We all have occasional colds, flu, or stomach upsets from foodborne infections. Usually these infections are self-limiting, and we become well in a few days or weeks. Other infectious diseases, such as pneumonia, tuberculosis, or “staph” infections, can be serious enough to require medical intervention to forestall disability and even death. Understanding how infectious microorganisms cause disease and how modern medicine and your immune system battle infections is essential for maintaining wellness.

Life is what happens when you're making other plans.

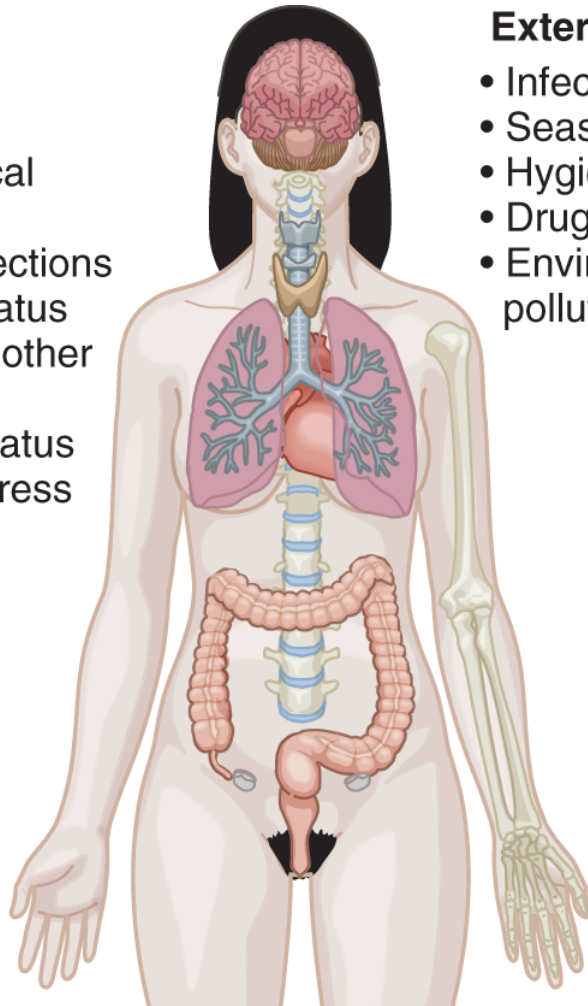
—John Lennon

Whether a person gets an infectious disease depends on a wide range of factors, including the competence of the immune system, nutritional status, stress, the presence of other diseases, and environmental conditions (**Figure 9.2**). For example, many people are exposed to bacteria that can cause pneumonia. However, pneumonia usually develops in older people whose immune systems are weak or in younger people who are susceptible to infections for any of a variety of reasons. Some people are more resistant to

infectious organisms than others because of genes that they inherited.

Internal

- Age
- Sex
- Immunological competence
- Previous infections
- Hormonal status
- Presence of other diseases
- Nutritional status
- Emotional stress level
- Heredity



External

- Infection in the community
- Season of year
- Hygiene and sanitation
- Drugs and medications
- Environmental pollutants or toxins

Figure 9.2 Factors Affecting the Risk of an Infectious Disease. Various internal and external factors determine whether disease will result from infections by viruses, bacteria, or other kinds of infectious agents.

Description

Tuberculosis (TB) is a serious lung infection caused by the bacterium *Mycobacterium tuberculosis*. Robert Koch, a famous 19th-century microbiologist, called TB the “disease of poverty” because it was associated with urban overcrowding, poor nutrition, and poor sanitation. Today, many people who are exposed to TB do not become sick because they enjoy good nutrition, good living

conditions, and are in good general health. However, TB still occurs where people live in squalor and poverty.

The Human Microbiome

Most microorganisms are not harmful when they are present in or on the human body. In fact, the human body contains 10 to 100 times more microorganisms than it does its own human cells. The vast majority of these microorganisms are bacteria; microorganisms classified as archaea, eukaryotes, and viruses also are present in smaller numbers. The overall composition of microorganisms inhabiting a human body is referred to as the **human microbiome**. Most of the organisms of the human microbiome inhabit the intestines (gut), the part of the digestive system that extends from the mouth to the anus. They are also found in the nose, vagina, and on the skin.

More than 10,000 different species of bacteria live on or in the human body (**Figure 9.3**). Overall, the microorganisms in the human microbiome produce more than 60,000 different proteins, which is 300 times the number of proteins that all the cells of the human body produce.

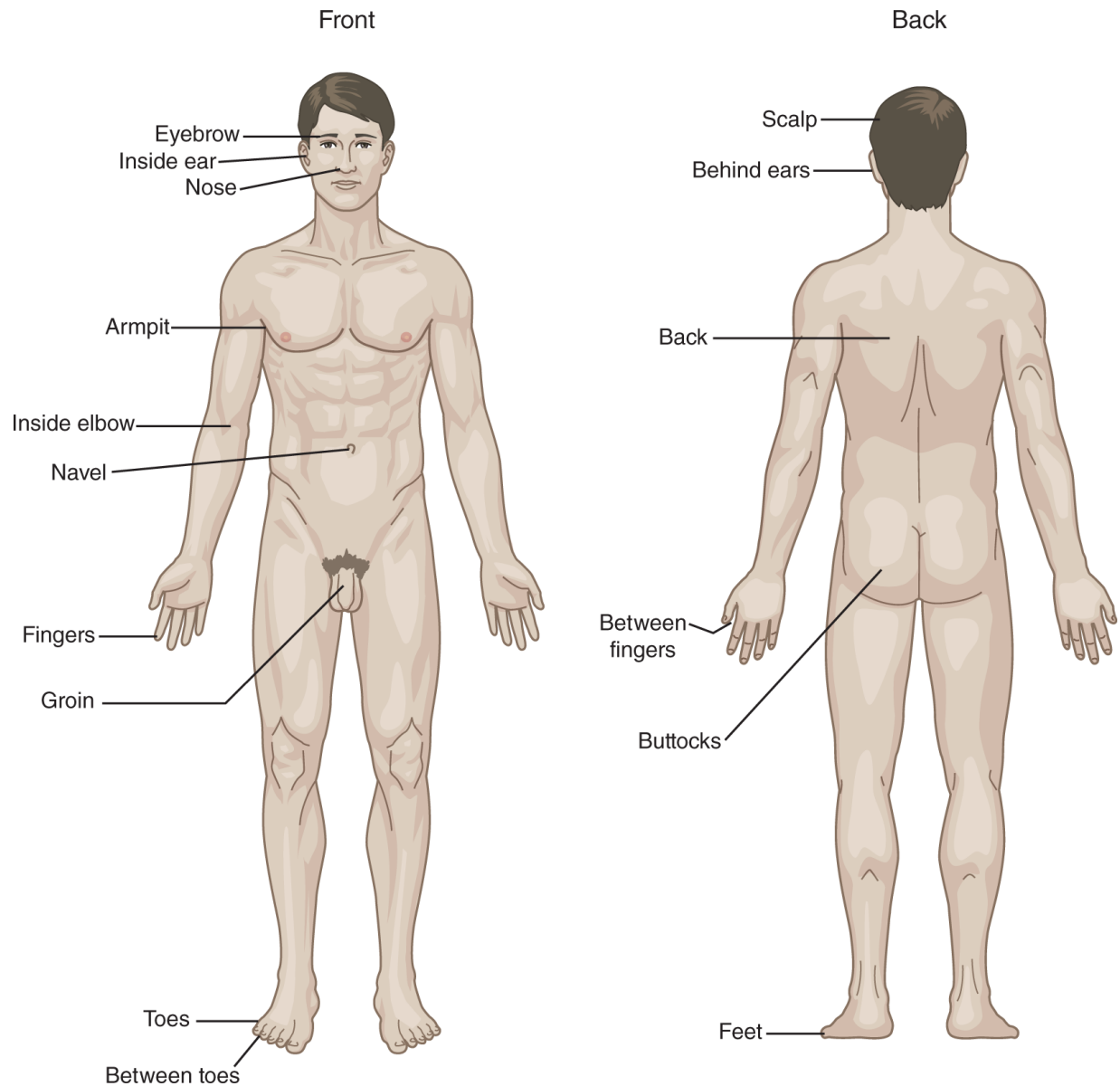


Figure 9.3 The Human Microbiome. An enormous diversity of microorganisms colonize many specific areas of the human body. These microorganisms perform many functions that protect us from diseases and infections. The overwhelming majority of microorganisms that make up the human microbiome are in the gut.

Description

This enormous diversity of microbial proteins in the human body can affect human metabolism and overall health—for example, susceptibility to certain infectious diseases, obesity, diabetes (types 1 and 2), allergies, asthma, autism, some cancers, chronic

gastrointestinal disorders, and responses to certain medicines. A mother's microbiome may even affect the health of her children (see the Wellness Guide box, "The Human Microbiome at Birth"). Many species of gut bacteria produce chemicals that are identical to neurotransmitters in the brain. Studies suggest that alterations in the composition of the human microbiome can affect mood and susceptibility to stress. The expression "I feel it in my gut" may one day be shown scientifically to be correct.

Some people may be tempted to consume dietary supplements or special foods touted to change the composition of the microbiome to mitigate anxiety, depression, sleeplessness, or other troubling mental states. Were it so. Without further research, it is perhaps best to make one's microbiome as healthy as possible by consuming a diet free of processed foods and consisting of fresh fruits and vegetables, nuts, seeds, and fiber, not much added sugar, food additives, pesticides, and alcohol. Eliminate exposure to tobacco smoke and other pollutants, antibiotics, and antiseptics and manage stress to reinvigorate the microbiome after taking medications, particularly antibiotics.



The Human Microbiome at Birth

While in the mother's uterus, a fetus is in a sterile environment. But that changes at birth when the baby enters the vagina, at which time its head becomes covered with vaginal fluid and millions of microorganisms enter the ears, nose, and mouth. The baby's entire digestive tract becomes flooded with microorganisms that are characteristic of the mother's vaginal microbiome. These microorganisms become the baby's first microbiome and begin to affect development of the immune system.

Because in-hospital Cesarean childbirth is sterile, a baby's first encounter with microorganisms is from the hands of hospital personnel and parents. Thus, the microbiome of a Cesarean baby is strikingly different from that of a baby delivered vaginally, which can affect the baby's immune system. Cesarean babies are twice as likely to develop asthma as vaginal babies do. Some doctors consider it vital to expose Cesarean babies to the mother's vaginal fluids to establish a healthy immune system.

Infectious Diseases

A remarkable variety of microorganisms, including bacteria, viruses, protozoa, yeast, and small worms, can infect the human body, causing disease, sickness, and death. All microorganisms except viruses are considered alive because they can grow and reproduce on their own. Viruses, however, are not considered alive because they only grow and reproduce after they infect a cell and usurp its cellular machinery to make more viruses. Some common human diseases caused by viruses are colds, flu, polio, hepatitis, chicken pox, mumps, measles, herpes, and HIV/AIDS. Each of the viruses that cause these diseases is different and infects a specific tissue or organ in the body.



Prevent Sickness While Traveling

The Centers for Disease Control and Prevention (CDC) provides travelers with the latest information of disease outbreaks and health risks around the world (cdc.gov/travel; 877-394-8747). The CDC advisory system consists of the following categories:

- “In the News” describes outbreaks or health risks that are newsworthy but present little or no health risk to travelers who take standard precautions such as drinking bottled water and not eating fresh fruits and vegetables, which could be contaminated.
- “Outbreak Notice” advises travelers of disease outbreaks in localized areas; travelers are advised to make sure vaccinations are up to date.
- “Travel Health Precaution” advises travelers to avoid specific areas or to take additional health precautions. Outbreaks of infectious diseases occurring over a large geographic area usually fall into this category. Travel is not restricted.
- “Travel Health Warning” advises travelers not to travel to the area unless absolutely necessary. Vacationers should cancel their plans.

The International Association for Medical Assistance provides the names of English-speaking physicians in a region being traveled to (<http://www.iamat.org>).



Other infectious diseases such as pneumonia, tuberculosis, cholera, plague, typhoid fever, and gonorrhea are caused by specific pathogenic bacteria. Often pathogenic bacteria and viruses cause disease only if the infected individual is already in a weakened state, particularly if the immune system is not functioning optimally.

Infectious diseases occur in the following patterns:

- *Endemic*, which is the usual amount of a particular infectious disease found in a population—for example, the common cold. With no public health intervention, an endemic infectious disease may continue to occur at its usual level indefinitely.
- *Cluster*, which is an increase in cases grouped in place and time that are suspected to be greater than the number expected. For example, diners at a particular restaurant on a particular day who become sickened with the foodborne bacterial infection of *E. coli* O157:H7.
- *Epidemic*, which is a greater than expected increase, often sudden, in the number of cases of an infectious disease among a population in a particular geographic region. Infectious disease epidemics require that infectious agents and susceptible hosts are present in large enough numbers to support disease transmission. Besides infections, epidemics can occur in noncommunicable diseases such as obesity, diabetes, and opiate misuse.
- *Pandemic*, which is an epidemic that has spread over several countries or continents, usually affecting a large number of

people. From its origin in Wuhan, China, COVID-19 quickly spread and became an epidemic. When the disease spread across several countries and all oceans to affect a unimaginable number of people, it was classified as a pandemic.

Among North Americans today, the most commonly occurring infectious diseases are caused by viruses (the common cold, influenza, COVID-19, hepatitis, HIV/AIDS) and bacteria (pneumonia, gonorrhea, chlamydia, Lyme Disease, and a variety of foodborne illnesses).

Virus-Caused Infectious Diseases

A virus is an extremely small (too small to visualize with a microscope) particle comprising biological parts that provide it with the singular capability to replicate itself, which can only occur inside a living cell. Because they cannot function independently, viruses are not considered alive.

Generally, a virus particle is spherical, separated from its environment by an assemblage or “coat” of protein molecules. Inside the particle are a few proteins to jump-start replication, and generally one small strand of genetic material, either deoxyribonucleic acid (DNA) or ribonucleic acid (RNA), to control the replication process.

The Common Cold

Colds are caused by viruses that infect cells of the breathing apparatus. Up to 80% of common colds are caused by the *human rhinovirus*, but many other viruses also infect the respiratory tract and cause colds. The average American spends about 5 years of his or her life suffering from colds. A cold caused by one virus does not protect a person from catching a cold caused by a different virus, which explains why colds can occur one after another or several times a year. It also explains why there is no vaccine for the common cold.

Although cold symptoms may be quite discomforting, colds generally do not result in long-term illness or death. Billions of dollars are spent by Americans every year on medications that are supposed to alleviate cold symptoms, such as sore throat, cough, congestion, runny nose, and muscle aches. Physicians joke that a cold will go away in about a week with rest and medications or in about 7 days if nothing is done. It takes the immune system about a week to produce the specific proteins (antibodies) that inactivate the viruses and for infected and damaged tissues to heal. High-tech modern medicine has nothing to offer that can prevent a cold,

although enormous research efforts have been expended to find a drug that would reduce the risk of catching a cold.

As was the case for many people during the COVID-19 lockdowns, anyone with a cold is caught between a rock and a hard place. Staying at home means lost income and possibly causing a major disruption at work. If a person decides to go to work despite being sick, sneezing, and coughing, other workers are likely to become infected.

Influenza

Influenza, or *flu*, is caused by a different kind of virus than the ones that cause colds. Compared to a cold, flu is a much more serious disease. The symptoms of flu are body aches, high fever, loss of appetite, and other complications. Infections of the respiratory system by a flu virus can so weaken people that they contract pneumonia, a bacterial infection, and die. For the pre-COVID 2019 flu season, the CDC estimates that 35.5 million people were sickened with influenza, 16.5 million people saw a healthcare provider for their illness, 490,600 people were hospitalized, and 34,200 people died. By comparison, in 2020, 630,000 Americans died of COVID-19.

There are many different strains of flu virus, and new strains arise continually. Because flu is so debilitating and serious, vaccines are prepared each year that are supposed to be specific to the expected influenza virus types for that year. Because it takes about a year to prepare and distribute a new flu vaccine, scientists have to guess which flu strain will be the cause of the next epidemic.

In some years, the flu vaccine is quite effective, but not in others. People with respiratory problems such as asthma, people with immune system deficiencies, and the elderly, who are most susceptible to pneumonia, are advised to get a flu shot each year to help prevent infection.

Never getting a cold or the flu is probably impossible. However, certain precautions can help reduce the risk. During seasons when colds and flu are present, avoid crowds as much as possible

because viruses are easily transmitted in droplets from people who are coughing or sneezing. Being in a classroom, theater, bus, subway, or any crowded place increases the risk of being infected. The viruses also are easily transmitted by bodily contact, such as shaking hands with someone with a cold who has recently wiped his or her nose or mouth. Wash your hands frequently during cold and flu season.

Hundreds of different strains of the flu virus can be constructed by reassortment of its eight segments of genetic RNA information (**Figure 9.4**). Two proteins on the surface of the virus determine which cells it can attach to and its lethality to specific species. The hemagglutinin (H) protein binds to specific receptors on cells. Usually, the particular H protein restricts the infection to one or several species of animals. The neuraminidase (N) protein helps the viruses escape from infected cells so that they can infect other cells. There are 15 different H proteins and about 9 different N proteins; the combinations of the two proteins characterize the particular strain of flu. For example, for the 2017–2018 flu season, vaccines were prepared for the H1N1 and H3N2 strains of virus.

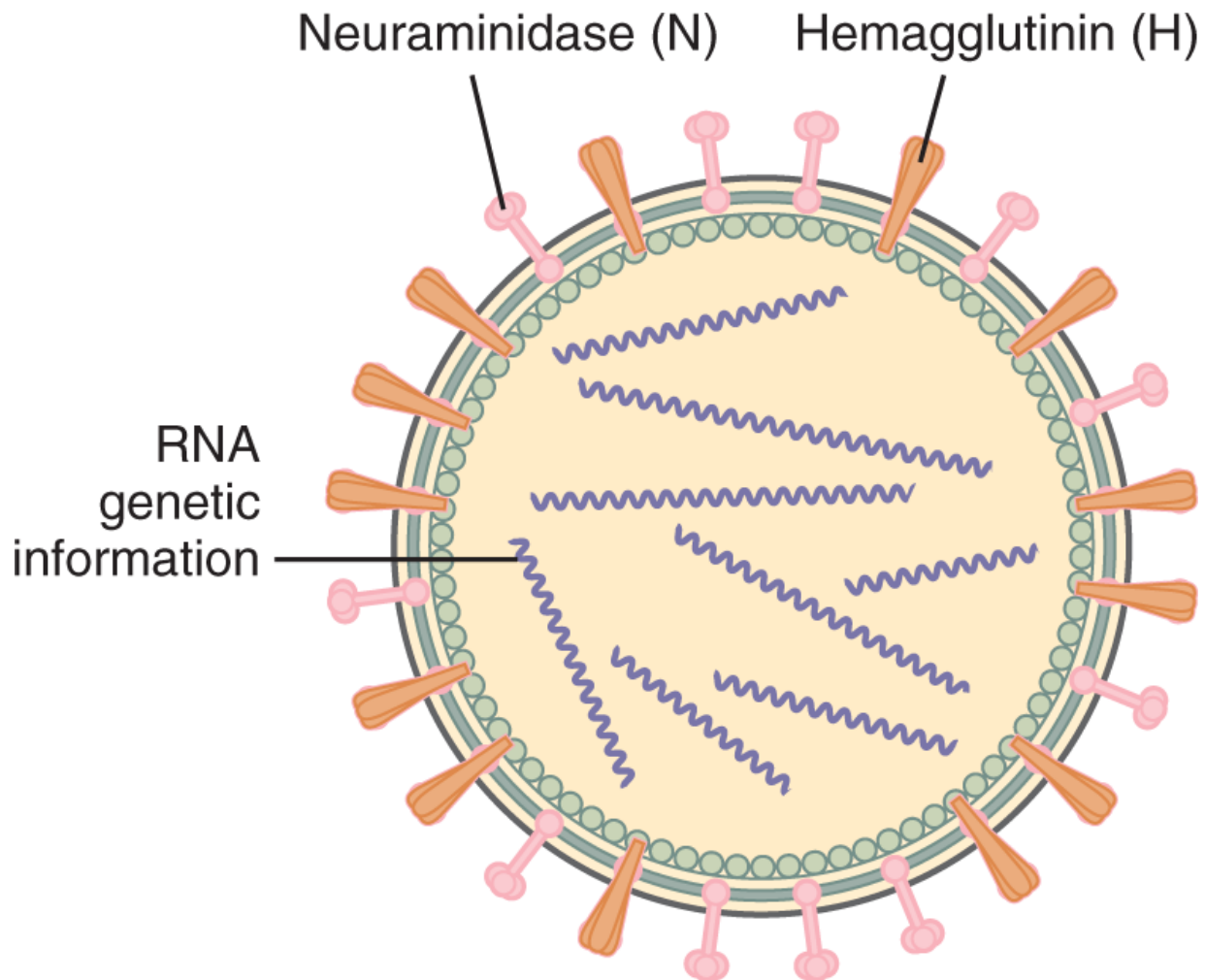


Figure 9.4 Diagram of an Influenza Virus. The genetic information is contained in eight segments of RNA. These can reassort and mutate to give rise to many different strains of viruses. Two proteins on the surface of each virus determine which species of animals it can infect. The hemagglutinin (H) protein recognizes specific cell receptors and allows the virus to infect those cells. The neuraminidase (N) protein helps new viruses to escape from infected cells.

Although there are a few medicines that kill or disable flu viruses, the major way people get better from a flu infection is through the workings of their own immune system. When flu viruses enter the body, cells in the immune system recognize them as foreign invaders and mount an attack to rid them from the body. The immune system also helps protect healthy cells and also dispose of cells weakened or killed by virus infection. Thus, recovering from an influenza virus

infection is dependent on a healthy and strong immune system. People whose immune systems are weak because of age (such as small children the elderly) or current or prior infection or are malnourished may have a harder time recovery from a bout of the flu. Vaccination (see below), which boosts immune system activity, is also an effective treatment for flu.

New human influenza viruses are developing all the time. They generally originate from viruses in nonhuman animals and spread to humans, generally by touch (pets or food) or through the air via coughing and sneezing.

Severe Acute Respiratory Syndromes (SARS)

In late 2002, a totally new virus-caused infectious disease, later named *Severe Acute Respiratory Syndrome* (SARS), emerged in Asia. Its flulike symptoms were fever, chills, muscle aches, headache, and occasionally diarrhea prior to dry cough, temperature near 100°F, and shortness of breath. SARS rapidly spread via air travel throughout the Asia and then to many other countries. Researchers quickly discovered that SARS spread from person to person by transmission of a never-before-identified corona virus, which they named SARS-CoV, by respiratory droplets produced when an infected person coughs or sneezes near someone. Investigations determined that SARS-CoV originated in wild bats, who passed it to farm-raised civets and other exotic animals and sold in live animal markets. Sellers of these animals were found to be infected with SARS-CoV. Transmission halted after the practice of selling these animals was stopped.

In 2012, another new SARS coronavirus arose in the country of Jordan. It became known as *Middle East Respiratory Syndrome Coronavirus* (MERS-CoV) and the disease it caused *Middle East Respiratory Syndrome* (MERS). As with other severe respiratory viruses, its symptoms were fever, cough and shortness of breath. About 30% of those infected died. Nearly all cases of MERS were linked through travel to, or residence in, countries in and near the

Arabian Peninsula. International health agencies continue to monitor the spread of MERS-CoV.

In November 2019, yet another unknown (“novel”) SARS coronavirus emerged in the city of Wuhan, China. Within 3 months, SARS-CoV-2, or COVID-19—as the virus infection came to be called—had spread throughout the world, which is the definition of a pandemic. As with related SARS coronaviruses, COVID-19 caused severe respiratory disease and also damage to other organs. Coronaviruses are named for the crownlike spikes on their surface (**Figure 9.5**).

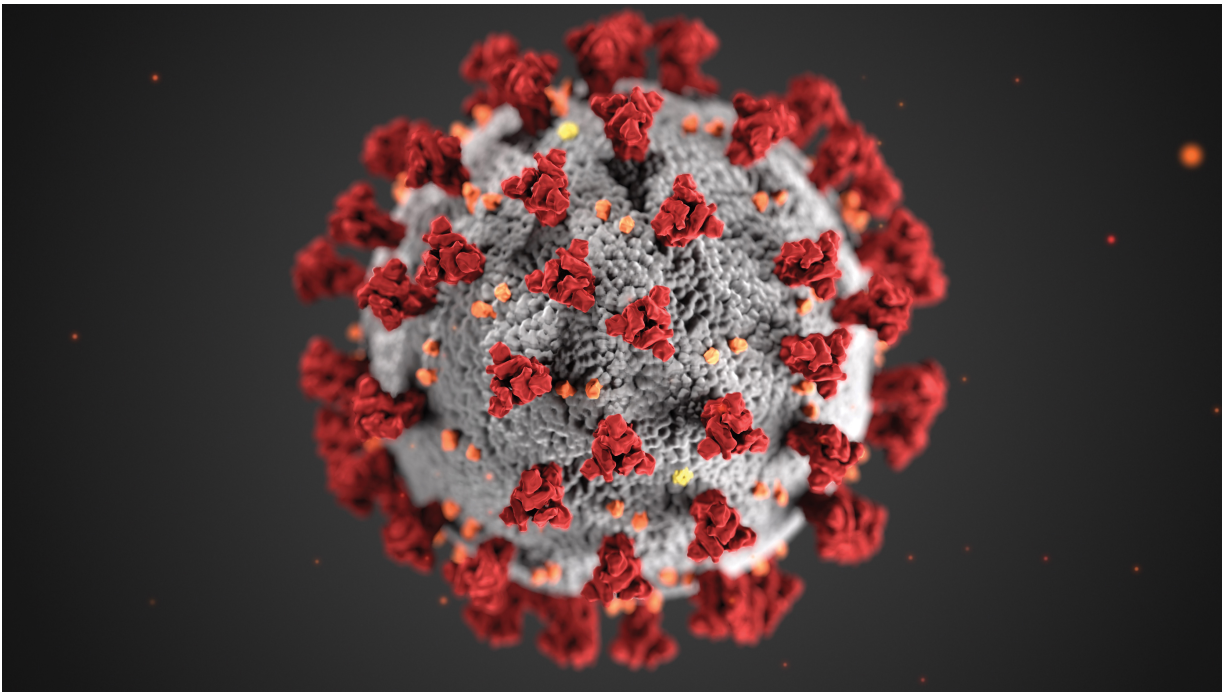


Figure 9.5 Illustration of the SARS-CoV-2 (COVID-19 Virus). Note the spikes (red protrusions) atop the outer surface of the virus. These impart the look of a corona—a crown—surrounding the main body of the virus. The spikes are responsible for sticking to and gaining entry to cells in the respiratory tract.

Alissa Eckert, MSMI; Dan Higgins, MAMS/CDC.

Human coronaviruses were first identified in the mid-1960s. Seven types of coronavirus can infect people. Four of these (identified as 229E, NL63, OC43, and HKU1) cause mild infections similar to

having a cold. The other three (MERS-CoV, SARS-CoV, and SARS-CoV-2) are responsible for serious and fatal respiratory infections. It is thought that the three deadly coronaviruses arose originally in animals and evolved to have the capacity to stick to and enter human cells (Kaye et al., 2020). As of October 2021 (this writing), in the United States more than 43 million cases of COVID-19 and more than 700,000 deaths had been reported. Worldwide there had been 219 million cases and more than 4.5 million deaths.

Bacteria-Caused Infectious Diseases

Unlike viruses, bacteria are individual living cells capable of life outside of a host's cells. Bacteria can be shaped as spheres (cocci), rods (bacilli), spirals (spirilla), commas (vibrios), or corkscrews (spirochaetes); many are visible with a light microscope. As with viral infections (see above), many bacterial infections involve invading host's cells and usurping the cells' own processes to make more bacteria. Some bacteria cause disease by multiplying so rapidly they crowd out host tissues and disrupt normal function or destroy cells and tissues outright.

Emerging Infectious Diseases

Emerging infectious diseases are infections that have newly appeared (or reappeared) among human populations in the prior 20 years or ones that may increase in the near future. Because they are new, humans have not developed immunity against them, and human communities may have weak prevention and control systems in place. In the past 45 years, about 40 previously unknown infectious diseases have appeared, among them SARS, MERS, Zika, swine flu, avian flu, Ebola, and most recently SARS-CoV-2, otherwise known as COVID-19. The reasons for the emergence (or reemergence) of so many infectious disease include the following:

- an increase in the world's human population, providing more hosts for potential pathogens and more opportunity for humans

to come in contact with wild animals used for food that may carry infectious pathogens;

- increased migration from rural regions to highly populated, crowded cities, thus making person-to-person virus transmission more efficient;
- international air travel, which allows viruses to relocate great distances with infected hosts;
- poverty, war, and other competitors for health resources;
- destructive ecological changes from economic development and unwise land use (with climate change, habitats are altered, permitting diseases to spread into new geographic areas);
- pathogens acquiring biological resistance to the destructive capacity of antimicrobial medications; and
- people not availing themselves of potent vaccines, either by choice or social unavailability.

Short of some technological breakthrough, at no time in the foreseeable future will humankind be able to prevent epidemics of infectious diseases. However, with constant high-level research and the willingness of governing bodies to pay attention to scientists' discoveries and warnings, surveillance of pathogen appearance and movement, and plans for immediate response to an epidemic, the toll of epidemics on societies and containing their spread into pandemics can be minimized—exactly what was *not* done with COVID-19.

Fighting Infectious Diseases

Infectious diseases are fought by (1) keeping infectious agents out of the body, (2) personal cleanliness and sanitation, (3) destruction with antibiotics and other drugs, (4) the immune system, and (5) vaccination. Stopping the spread of infectious organisms requires that they be destroyed both in infected people and in the environment. Thus, reducing the burden of infectious diseases is the responsibility both of individuals and of communities. Individuals need to practice good hygiene, avoid unsafe sex, and make sure required **immunizations** are up-to-date, especially for children. Communities have a responsibility to make sure water is safe to drink, the food supply is not contaminated, garbage and wastes do not pollute the environment, and people receive education and counseling on how to avoid infectious diseases.

Fighting Infectious Diseases: Keeping Infectious Organisms Out of the Body

The best way to avoid infectious diseases caused by pathogenic microorganisms is to keep them out of the body. The skin and mucus membranes prevent the entry of most microorganisms into the body by functioning as physical barriers. That is why a wound often exposes the body to infection (**Figure 9.6**). The skin is mildly acidic and covered with beneficial bacteria; it provides a poor habitat for most harmful microorganisms.

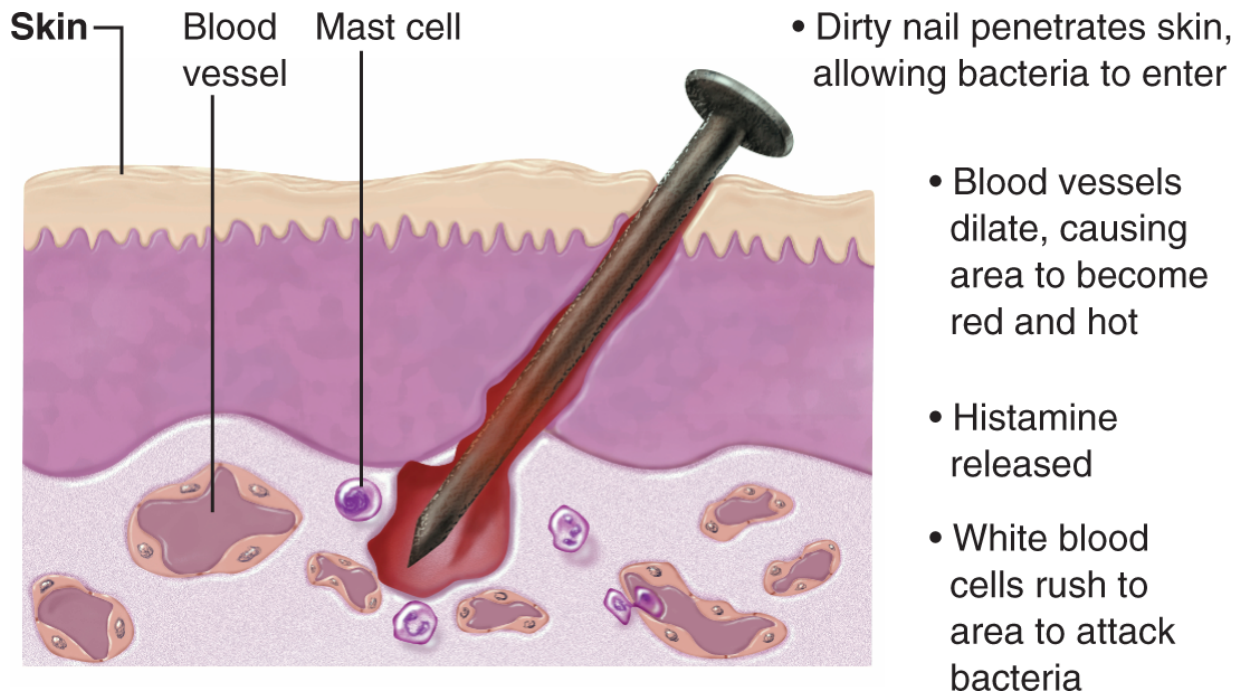


Figure 9.6 Inflammation Response. Penetration of the skin by any unsterile sharp object often produces an inflammation response, the normal response of the body to injury or infection.

Description

The eyes, nose, throat, and breathing passages are protected by mucus membranes that continuously produce secretions that flush away harmful organisms and particles. Mucus membranes also secrete enzymes that can destroy toxic substances. The mouth, digestive system, and excretory organs also are protected by membranes that guard the internal organs.

Tears keep the surface of the eyes moist and serve to wash away foreign particles. Wax secreted from the ears protects the delicate hearing apparatus. The mucus coating of the respiratory tract is sticky and provides a trap for irritating particles and microorganisms in the air; microscopic hairs called *cilia* keep the mucus moving out of the bronchial tubes. Coughing and spitting are mechanisms that remove foreign material from the breathing passages. Sneezing and blowing the nose eliminate irritating particles that are inhaled.

If microorganisms or foreign particles penetrate the skin and enter the blood, they soon encounter specialized cells called **leukocytes**,

the colorless white blood cells that can be distinguished from the red blood cells that transport oxygen. Only about 1 in 700 cells in the blood is a leukocyte, but their number can increase dramatically if an acute infection occurs. That is why blood is tested for the number of white blood cells when an infection is suspected.

Specialized white blood cells called **macrophages** are associated with specific organs and are vital to the body's internal defense mechanisms. Macrophages are able to engulf and digest foreign cells and particles that invade the body. Organ-specific macrophages protect the lungs, stomach, and other organs from damage by foreign substances.

Cells and enzymes in the blood quickly form clots that seal off any break in the skin, thereby preventing the entry of harmful substances and infectious organisms. If some bacteria do enter the wound before it is sealed off, other special cells that are part of the immune system attack and destroy the invaders.

Fighting Infectious Diseases: Personal Cleanliness and Sanitation

In the late 19th century, French scientist Louis Pasteur established the *germ theory of disease* by showing that microscopic organisms could cause infections and disease. Pasteur also discovered that these microorganisms could be rendered harmless by heat or by treatment with certain chemicals. Today, pasteurization, the process of warming raw foods such as milk and other dairy products to make them safe to consume, is common practice. Using chemicals that kill infecting organisms—called *antiseptics* (*sepsis* is the medical word for a severe reaction to infection)—became common after physician Joseph Lister successfully implemented Pasteur's advice in his own hospital in Scotland. (The antiseptic mouthwash Listerine is named after him.) Before the advent of antiseptics, surgery or childbirth in a hospital often led to death from subsequent infection.

Today, dozens of over-the-counter wash products, including liquid, foam, and gel hand soaps; bar soaps; and body washes, contain antibacterial ingredients. According to the U.S. Food and Drug

Administration (2020), scientific evidence showing that these products are better at preventing illness than washing with plain soap and water is inconclusive. Moreover, there may be harmful effects from using such chemicals, which is the reason that 19 of them have been banned for use in over-the-counter soaps. Also, the wide use of these antibacterial agents increases the risk of organisms developing resistance to antibacterial chemicals, including antibiotic drugs. The Food and Drug Administration's (FDA's) best advice for cleaning hands is to wash with plain soap and warm water for about 20 seconds each time (the length of time to sing the ABC song)). This advice does not hold for antiseptics commonly used in surgery and nonsurgical antiseptics like hand sanitizers used to protect against COVID-19 transmission that contain at least 60% ethyl alcohol (ethanol) or isopropyl alcohol. Products containing methanol (methyl alcohol) or 1-propanol are toxic and should not be used on the skin.

Indoor plumbing, sanitation, sterile techniques, and public health programs were not actively implemented in the United States until the beginning of the 20th century. Only then did the incidence of many infectious diseases begin to decline dramatically. Many medical historians claim that sanitation is the most significant medical advance of all time because it contributed to preventing millions of cases of infectious disease caused by contaminated water and food.

Fighting Infectious Diseases: Antibiotics

In the late 1940s, the chemical **penicillin**, produced by a species of mold, was found to cure many kinds of bacterial infections. Today, hundreds of bacteria-killing chemicals called **antibiotics** or *antimicrobials* have been developed to treat diseases caused by viruses, protozoa, worms, and other microorganisms. Antibiotics or antimicrobials block essential biochemical processes in infecting organisms, thereby preventing them from growing. Antibiotics kill both harmful and helpful bacteria in the body; however, once the harmful bacteria have been killed, helpful bacteria quickly repopulate

their normal sites. Antibiotics do not prevent the growth of viruses because viruses are not living cells.

We must always follow someone looking for truth, and we must always run away from anyone who finds it.

—**André Gide**, French author, Nobel Prize in Literature

Antibiotic Resistance

Not long after they were first discovered, antibiotics were hailed as wonder drugs capable of curing some of the most deadly bacterial infectious diseases. And that expectation came to pass. Antibiotics have been exceptionally useful drugs over the past 80 years, but now there is a decline in their effectiveness because many pathogenic bacteria have acquired new genes that make them resistant to one or several of the most effective antibiotics. These antibiotic-resistant genes can evolve within a species of bacteria or they can acquire them from other species of bacteria. In this way, bacteria that cause gonorrhea, pneumonia, tuberculosis, and so-called staph infections have become resistant to many previously effective antibiotics.

For example, one of the many different strains of tuberculosis called *extensively drug-resistant TB* (XDR-TB) has become resistant to all of the antibiotics usually prescribed to cure ordinary tuberculosis infections. The only treatment now available for XDR-TB consists of 2 years of treatment with several highly toxic drugs; 50% to 80% of patients die from the treatment. Those who survive often suffer permanent nerve damage and other serious complications caused by the drugs. What makes XDR-TB infection particularly worrisome is that it is transmitted by close personal contact; all family members may become infected. Besides TB, many sexually transmitted diseases, such as chlamydia and gonorrhea, are now resistant to most of the antibiotics that have been effective previously. According to the U.S. Centers for Disease Control (2021),

in 2020 about 3 million antibiotic-resistant infections occurred in the United States and more than 35,000 people die as a result. Antibiotic resistance in 17 diseases is considered an urgent or serious threat to public health.

The antibiotic methicillin had been used for years as a highly effective treatment for skin and soft tissue infections caused by the bacterium *Staphylococcus aureus*, the “Staph” previously mentioned. Over the years, bacteria of this species mutated until a highly virulent strain, *methicillin-resistant Staphylococcus aureus* (MRSA), emerged. These virulent staph infections are often found among patients in hospitals. In 2016, Daniel Fells, a 10-year veteran tight end for the New York Giants, had to retire from football because of a MRSA foot infection thought to be contracted from treatment of an ankle injury with MRSA-contaminated medical equipment. Fells underwent 10 surgeries to save his foot and his life.

Antibiotic resistance results from practices in health care and agriculture. In health care, extensive use of antibiotics by physicians and in hospitals gives rise to antibiotic-resistant bacteria through inadvertent transmission via healthcare staff. Among community-based doctors, it is estimated that more than half of the prescriptions that are written for antibiotics are unnecessary because they are generally written for people with colds and flu. Colds and flu are caused by viruses, which cannot be killed by antibiotics. So why do doctors prescribe them when they are useless? One reason is that the doctor has made a diagnostic or treatment error. Another reason is that the patient, or a patient’s parent in the case of a child, demands an antibiotic to treat some symptoms, and the doctor complies. Either way, antibiotics unnecessarily enter the environment and contribute to the problem of antibiotic resistance.

Antibacterials are added to soaps, deodorants, hand wipes, sprays—almost any product used to fight “germs.” Most bacteria that humans encounter in the environment pose little or no health danger. In fact, most bacteria on the skin and in the digestive system are beneficial and protect people in countless ways. Increasingly, countries are banning the unnecessary and indiscriminate use of

antibiotics and insisting that these essential drugs be reserved for the treatment of serious human diseases.

In agriculture, about 50% of all antibiotic chemicals used in the United States (about 13 million pounds a year) are routinely given to farm animals to prevent them from getting infections that would make them sick and lessen their weight and marketability. Some of the bacteria that the antibiotics are supposed to kill are resistant, and after awhile the property of resistance is passed from animal to animal and even to soil bacteria via animal feces. If the animal flesh or the water runoff from an animal production facility is contaminated with resistant bacteria, the property of resistance can be transferred to bacteria that infect people.

When animals are slaughtered and processed for food, these bacteria can contaminate meat or other animal products. Animal waste can also carry antibiotic-resistant bacteria. Fruits, vegetables, and other produce can become contaminated through contact with soil or water containing waste from animals. People can get infections from handling or eating meat, seafood, milk, eggs, fruits, and vegetables contaminated with resistant bacteria.

In response to scientists' warning about the increase in antibiotic resistance, the World Health Organization has implemented multiple initiatives to address the root causes of antimicrobial resistance across multiple sectors, especially human health, animal health, and agriculture. In 2020, the European Commission adopted its Farm to Fork strategy to reduce by 50% sales of antimicrobials for farmed animals and in aquaculture by 2030 and to promote a more prudent and responsible use of antimicrobials in animals. In the United States, the federal government implemented a National Strategy for Combating Antibiotic-Resistant Bacteria, underscoring the need for a response to this threat. The strategy thus far involves facilitating appropriate and responsible use and development of new antimicrobials and research on surveillance and regulatory methods to limit antimicrobial resistance. Even McDonald's, which buys more than a billion pounds of beef a year, has told its suppliers all over the world to limit the use of antibiotics in producing beef. Using their

dollars as leverage, perhaps consumers can influence other purveyors of foods to do the same.

Whereas governments and health services may want what is necessary for the common good, pharmaceutical companies and agribusiness want to maximize profits. Because these two goals are often mutually exclusive, many believe that only a total ban on the use of antibiotics in animal feed will preserve human health.

In the 1990s, the FDA approved the addition of the drugs Baytril and SaraFlox to poultry feed. These two drugs belong to a class of extremely effective antibiotics called *fluoroquinolones*; members of this family of drugs are used to treat the bacteria that cause anthrax and foodborne infections. Scientists and the American Medical Association warned that such use in animal feed would lead to the emergence of antibiotic-resistant strains. After several years, this is exactly what happened, and the FDA tried to ban the use of the drugs in livestock. Drug companies fought the FDA, and it was years before the drugs were finally withdrawn from the market. But it was too late; resistance had already occurred. Fluoroquinolone drugs are now much less effective in treating human staph infections.

In 2021 (to be effective in 2023), the FDA issued a guidance for the agricultural industry that will bring all medically important antibiotics used in food-producing animals under veterinary oversight. This policy restricts the ability of food producers to purchase over-the-counter animal antibiotics without a prescription. The goal is to promote more judicious use of these drugs. By not banning the use of antibiotics in animal feed the federal government is, once again, sitting this one out.

Fighting Infectious Diseases: The Immune System

Many infectious microorganisms have the potential to cause disease in the human body. However, most people stay well most of the time because humans have a potent defense—the **immune system**—that can destroy those organisms if they invade the body.



Self-Care: The Calming Breath

Life has its upsets, but upsetting emotions like anger, shame, disappointment, fear, and anxiety don't have to rule you. You may not be able to do much about an immediate upsetting situation, but you can do something to relieve some of its emotional intensity by taking a deep breath—in fact, by taking three or more of a special kind of deep breath called the *calming breath*.

When you're emotionally upset, your brain's sympathetic nervous system (SNS) is firing on all cylinders. Your heart beats faster, your muscles tense, your breathing is shallow, and your mind is focused simultaneously on safety and fighting back. That state of arousal is rarely fun.

Whereas SNS arousal is all about “fight and flight,” its biological sibling, the brain's parasympathetic nervous system (PNS), is about “rest and digest.” Activation of the PNS can make a person feel calm, cool, and collected. This is where the calming breath comes in. Biologically, the SNS and PNS cannot be highly activated at the same time. The PNS, via the vagus nerve, controls breathing rhythm. By using your mind to alter your breathing, you can alter your emotional state—from SNS untamed arousal to PNS calm and centered.

There are two types of breathing: *thoracic*, which is shallow and located in the chest, and *diaphragmatic*, which is located further south in the belly. Upset breathing tends to be thoracic; calm breathing tends to be diaphragmatic. So, when you're upset, use your mind to change your breathing from thoracic to diaphragmatic to get to a state of calm. Here's how:

1. Find a place to be still. Stand or choose a posture that works for you (options below); in each case, rest your arms in your lap or at your side, hands relaxed, palms up (no fists).
 - Sit in a chair, legs uncrossed, feet flat on the floor, back straight (no slouching).
 - Sit on the floor on a cushion or soft rug with your back against something firm.
 - Lie on your back on something soft with your feet 12–15 inches apart.
2. Pull your shoulders down from your ears. Focus your mind on the feeling of your body touching the chair, wall, or floor. Feel gravity anchoring you to Earth. Close eyes or leave open. Note upsetting thoughts but let them pass through your mind like clouds in the sky.
3. Take three calming breaths like so: Inhale for a count of 4, hold for a count of 5, then exhale for a count of 7. (If this rhythm is difficult for you, it's OK to alter the timing while keeping the exhale longer than the other steps).
4. After three calming breaths, breathe normally for a few minutes. Observe your feelings and body sensations. Repeat another calming breath if desired.

Practice calming breath at least once a day anytime and anywhere it suits you. Morning practice can get your day off to a good start; bedtime practice can get your mind

and body ready for sleep. Calming breath may take some getting used to but stick with it. You won't be sorry.

Resources

Dr. Andrew Weil's calming breath demonstration: drweil.com/videos-features/videos/the-4-7-8-breath-health-benefits-demonstration/

Breathe Bubble video from Calm.com. Coaches four cycles of 4-4-4-4 calming breath: <https://www.youtube.com/watch?v=uxayUBd6T7M>

Coherent Breathing . . . explains calming breath: verywellmind.com/an-overview-of-coherent-breathing-4178943

Hopper, S. I., Murray, S. L., Ferrara, L. R., & Singleton, J. K. (2019). Effectiveness of diaphragmatic breathing for reducing physiological and psychological stress in adults: A quantitative systematic review. *JBIS Database*, 17, 1855–1876. doi: 10.11124/JBISRIR-2017-003848

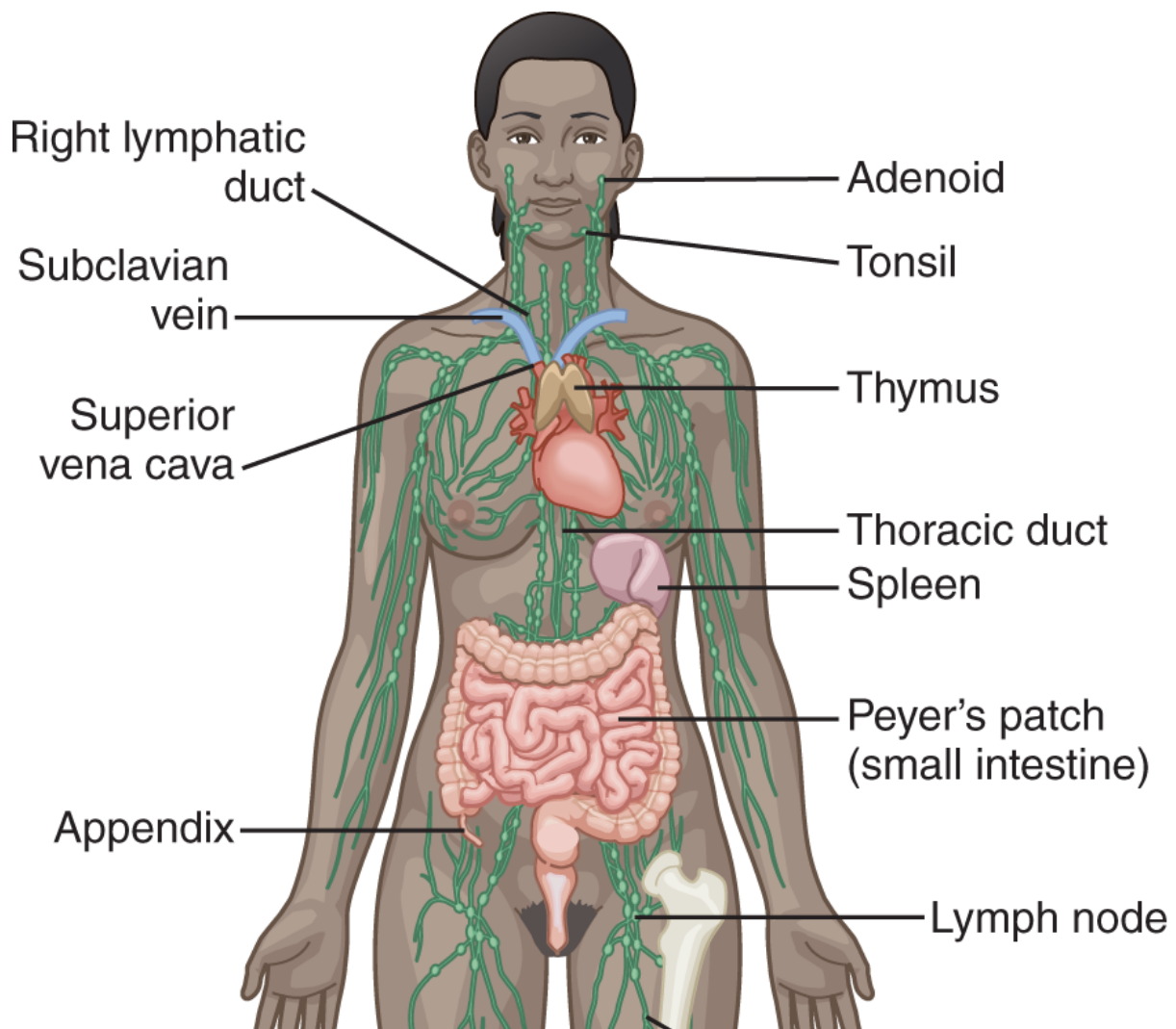
All mammals have similar immune systems, which evolved with the earliest animals on Earth. Without a functional immune system, people and animals would quickly succumb to the countless infectious microorganisms in the environment.

The immune system takes time to develop. At birth, a baby is protected from infectious diseases by protective agents in the mother's blood and passed on to the newborn. Babies also receive protection from breast milk, which helps to protect them while their own immune systems mature during the first year or so of life.

Many factors can adversely affect the development and functioning of the immune system. Poor nutrition is perhaps the most important factor, especially early in life. Without a healthy diet, a child is extremely susceptible to infections that a weak immune system cannot fight. Immunity is also strengthened when bacteria that constitute the mother's microbiome also are transferred to the baby as it passes through the birth canal. Inadequate nutrition and infectious diseases are the principal reasons that children die in many undeveloped and impoverished countries of the world. Other factors that affect the development or functions of the immune system are hereditary disorders, viral infections, stress, and many drugs and chemicals, including alcohol and tobacco.

The Lymphatic System

The immune system is part of a larger and more complex system called the **lymphatic system**, which has many organs and cells that must act in concert to protect people from infectious diseases (**Figure 9.7**). The lymphatic vessels contain fluid called *lymph*. At various intervals along the lymphatic vessels are nodules called **lymph nodes**. The “swollen glands” that people experience in the neck, under the arms, in the groin, or in other areas of the body are caused by enlarged lymph nodes that are engaged in filtering out infectious organisms or foreign particles capable of causing disease. Thus, swollen and sore lymph nodes are a sign that the body is fighting an infection.



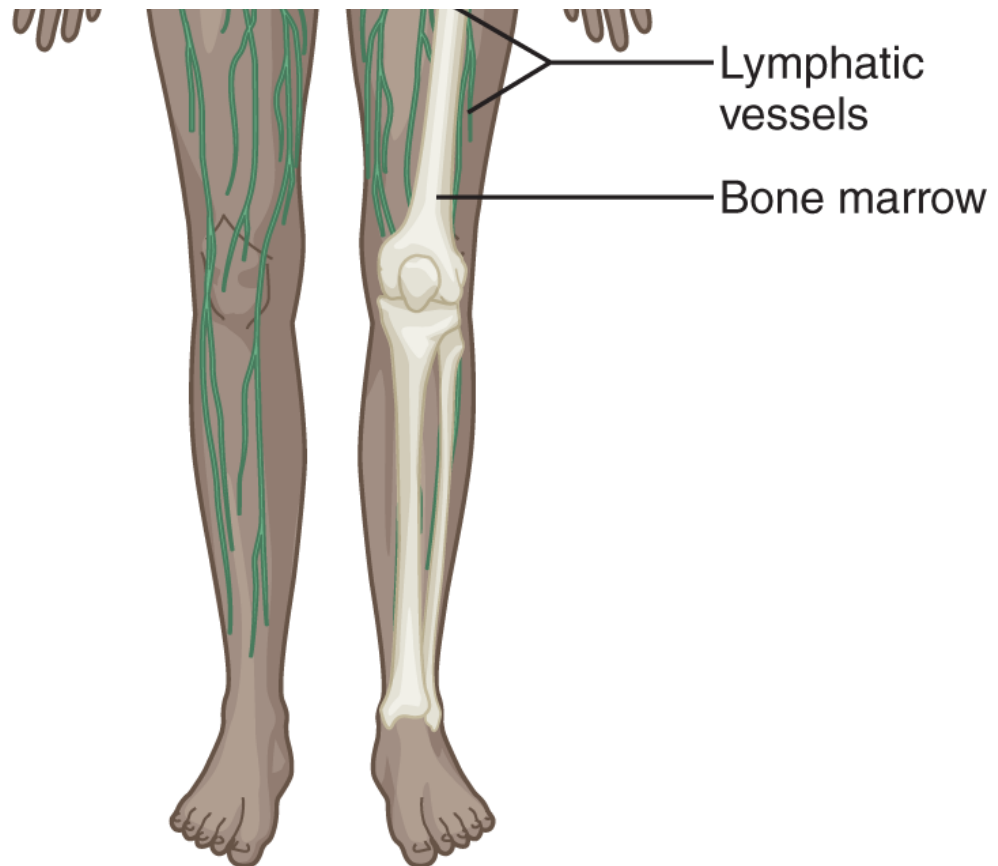



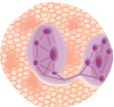
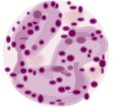


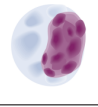
Figure 9.7 The Lymphatic and Immune Systems. Bone marrow, lymph nodes, and other organs of the immune system are shown. The lymphatic system performs many functions in protecting the body from infectious diseases.

Description

Bone marrow, tonsils, adenoids, the spleen, and the thymus all produce cells that allow the body to mount an immune response against infectious microorganisms. When bacteria or viruses invade the body, the immune system produces diverse kinds of white blood cells that function in different ways to destroy them ([Table 9.2](#)).

TABLE 9.2	Specialized White Blood Cells
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All white blood cells originate in bone marrow and become specialized as they mature in different organs. Specialized cells carry out different functions of the immune system. The B cells and T cells recognize foreign proteins on infectious bacteria, viruses, and other organisms and substances. B cells are converted to plasma cells that manufacture antibodies.

White Blood Cell Type	Description	Function	Life Span
Neutrophil 	Spherical; with many-lobed nucleus, no hemoglobin, pink-purple cytoplasmic granules	Cellular defense—phagocytosis of small microorganisms.	Hours to 3 days
Eosinophil 	Spherical; two-lobed nucleus, no hemoglobin, orange-red staining cytoplasmic granules	Cellular defense—phagocytosis of large microorganisms such as parasitic worms; releases anti-inflammatory substances in allergic reactions.	8 to 12 days
Basophil 	Spherical; two-lobed nucleus, no hemoglobin, large purple-staining cytoplasmic granules	Inflammatory response—contains granules that rupture and release chemicals enhancing inflammatory response.	Hours to 3 days
Monocyte 	Spherical; single nucleus shaped like kidney bean, no cytoplasmic granules, cytoplasm often blue in color	Converted to macrophages, which are large cells that entrap microorganisms and other foreign matter.	Days to months
B lymphocyte 	Spherical; round singular nucleus, no cytoplasmic granules	Immune system response and regulation; antibody production sometimes causes allergic response.	Days to years
T lymphocyte 	Spherical; round singular nucleus, no cytoplasmic granules	Immune system response and regulation; cellular immune response.	Days to years

Description

The **T cells** (also called *T lymphocytes*) circulating in the blood are ready to attack infectious organisms immediately, because T cells recognize the “foreignness” of specific proteins on the surface of bacteria, viruses, and other pathogens. The response of the T cells is called **cell-mediated immunity** because the T cells attach directly to the infectious organisms and inactivate them. Once cells have been identified as foreign by the T cells, the macrophages and other immune system cells complete the process of destroying and eliminating them from the body.

The **B cells** (also called *B lymphocytes*) constitute the most effective immune system defense; the response of the B cells is called **humoral immunity**. The B cells produce **Antibodies** are proteins that recognize and inactivate viruses, bacteria, and harmful substances that can cause disease. Antibodies are highly specific for one particular part, usually a protein or part of a protein, of a foreign organism or substance.

The foreign proteins on viruses, bacteria, and other infectious organisms that trigger an immune response are called **antigens** (*antibody generators*). Every person has a collection of B cells circulating in the blood, each of them designed to recognize a specific protein on any infectious organism that may be encountered in the future. Once a particular B cell is chemically programmed to recognize a foreign antigen, it will reproduce itself and make more B cells just like itself. Eventually, these B cells (at this stage called *plasma cells*) manufacture vast amounts of one specific antibody. These specific antibodies comprise an army of defenders suited to find and destroy a specific enemy. Once the antibodies have recognized and inactivated invading microorganisms, other white blood cells finish the job of destruction. To produce the correct antibodies in large amounts takes about a week after an infection.

The B cells and T cells interact among themselves in complex ways to produce a full-fledged immune response. Small molecules called **cytokines** coordinate the activities of the B cells and T cells. Cytokines such as interferons and interleukins, that regulate functions of the immune system are manufactured by biotechnology companies. Some of these products are used in the treatment of cancer and other diseases in which the functions of the immune system are impaired.

T cells are also divided into different classes according to their specific functions. *Helper T cells* increase the proliferation of B cells; *killer T cells* destroy cancer cells and pathogenic organisms; suppressor T cells retard the growth of other immune system cells. A special class of T cells called *CD4 cells* are important indicators in the diagnosis and development of AIDS. When the level of CD4 cells in the blood falls, a person becomes extremely susceptible to

infection by many different kinds of microorganisms, causing one of the more than two dozen infectious diseases that characterize AIDS.

Fighting Infectious Diseases: Vaccination

One of the great achievements of modern medicine has been the development of vaccinations (immunizations) to prevent many serious infectious diseases. Viral diseases such as whooping cough, measles, mumps, hepatitis, smallpox, and polio have been virtually eliminated throughout the world because of mass vaccination.

Vaccination is the administration, usually by injection (hence the name “shot”), of substances called **vaccines**. The purpose of vaccination is to present to the body’s immune system chemicals that activate an immune response—that is, produce B cells that are factories for antibodies specific to the chemical in the vaccine. These B cells become *memory cells* ready to confront a disease-causing organism by switching on the production of defending antibodies needed to destroy an infectious agent.

For example, the crippling disease poliomyelitis has been virtually eradicated in the United States as a result of the widespread use of the polio virus vaccine. The first polio vaccine was developed in 1954 by Jonas Salk using chemically inactivated infectious polio viruses. The polio vaccine now used is derived from a genetically inactivated virus developed in 1957 by Albert Sabin. Both methods of viral inactivation prevent the inactivated virus from causing disease, but because their chemistry is not changed, the inactivated viruses still confer long-lasting immunity.

A suite of vaccinations is recommended for both children and adults (for recommended immunization schedules, see cdc.gov/vaccines/schedules/index.html). Other vaccinations are recommended only for people at particular risk of exposure to a certain disease—for example, travelers to a country where cholera, typhoid fever, or hepatitis A is prevalent. Vaccination for influenza is recommended for people susceptible to lung infections such as children and those who are elderly or have asthma. Elderly people are advised to get vaccinated against a skin ailment called *shingles*.

As a result of vaccinations, there has been a 99% reduction in cases of measles, diphtheria, mumps, and rubella and a 97% reduction in whooping cough (pertussis) in the United States.

Vaccination Risks

Since 1912, the CDC has kept records of disease incidence before and after the introduction of a vaccine. Often people experience mild reactions (e.g., soreness at the site of injection) that generally disappear within a few days. About 1 per 1 million vaccinations results in serious reaction. Although in rare instances these cases can be tragic, vaccination is nevertheless far safer than taking an aspirin. Nevertheless, some people make false claims about specific vaccines and adverse effects, including the following:

Vaccine	Adverse Effect
Measles	Autism
Diphtheria, pertussis, and tetanus	Sudden infant death syndrome
<i>Haemophilus influenzae</i> type B	Diabetes
Hepatitis B	Multiple sclerosis

Given the frequency and number of childhood vaccinations, it is not surprising that untoward symptoms occur once in a while by chance shortly after a child has been vaccinated. It also is not surprising that distraught parents, looking for a cause, blame the vaccination.

Controversy over vaccinations has arisen from the claim that a mercury-based preservative (thimerosal) in vaccines is the cause of a measured increase in autism among young children. The preservative has been used for years to prevent deterioration of the vaccines, particularly where refrigeration is not available. Because of parents' concerns, thimerosal was removed from all U.S. vaccines in 1999. Several studies have concluded that there is no causal

association between thimerosal-containing vaccines and childhood autism (U.S. Food and Drug Administration, 2017a).

Despite scientific evidence that supports the remarkable safety record of vaccinations, parents whose children acquired debilitating conditions after being vaccinated began to sue pharmaceutical companies that manufactured vaccines. Some of these suits were successful, and companies began to discontinue the manufacture of essential vaccines. To protect the nation's vaccine supply, Congress passed a law that permitted financial compensation to parents who could prove that their child's health was severely damaged by administration of a vaccine. There is also a law protecting vaccine manufacturers from being sued on grounds that a vaccine is defective.

Understanding Allergies

Allergies are the immune system's response to foreign substances called **allergens**. Pollens, molds, house dust, animal hair, foods, drugs, chemicals, and many other substances can act as allergens. The body responds to allergens by manufacturing a particular class of antibodies (immunoglobulin E, or IgE) that triggers an allergic reaction (**Figure 9.8**). No one knows why allergic responses evolved or what benefit they might have provided, but millions of people today can attest to the misery caused by allergic responses.

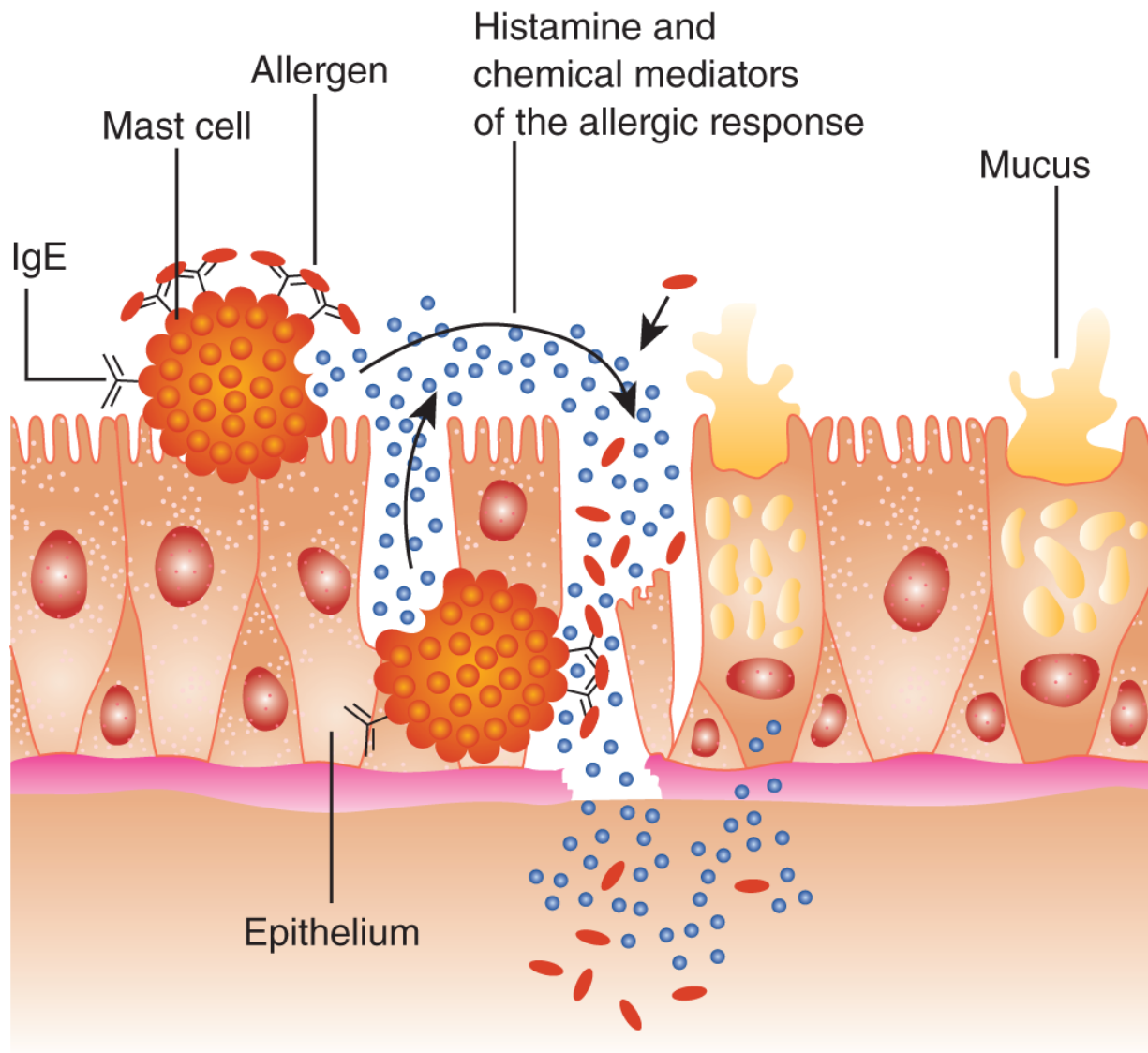


Figure 9.8 Chemistry of an Allergic Reaction. An allergen (a substance from a plant, insect, or other organism) binds to antibody proteins (IgE) on mast cells. This triggers the release of histamines and other inflammatory substances that characterize the allergic response. These reactions occur mainly in the nose, lungs, skin, and digestive tract.

Description

Chemistry of an Allergic Reaction

The allergic reaction is usually accompanied by the secretion of mucus and the release of **histamine**, an inflammatory chemical that is abundant in cells of the skin, respiratory passages, and digestive tract. That is why most allergic reactions are associated with the skin

(eczema, hives, contact dermatitis), the respiratory passages (asthma, hay fever), and the digestive tract (swelling, vomiting, diarrhea).

Contact Dermatitis

Contact dermatitis is an inflammation of the skin that affects millions of people because many of the things we touch or put on our skin can cause allergic reactions that manifest as rashes, blisters, or hives. Walking in the woods where poison ivy or poison oak grows can produce serious rashes in susceptible persons. Peeling a mango can cause people who are allergic to the skin of this fruit to break out in a rash; however, they usually can eat the flesh of the fruit without experiencing a reaction.

Contact dermatitis actually arises by two distinct mechanisms: *allergic contact dermatitis* involves reactions of the body's immune system cells with specific proteins that contact the skin, resulting in redness, itching, and inflammation. In contrast, *irritant contact dermatitis* does not involve an allergic response but rather is caused by cell damage and inflammation as a direct result of substances that contact the skin. Diaper rash is a common form of irritant dermatitis in babies. The hands also are frequently affected by irritant dermatitis arising from frequent contact with hard surface cleansers. Cosmetics also may cause irritant dermatitis, especially scented soaps and skin creams. When all allergy tests are negative and a skin condition persists, the condition is diagnosed as irritant dermatitis.

One increasingly common form of allergic contact dermatitis is latex allergy. It is estimated that latex allergies range from 1% to 6% in the general population, and among people who work in hospitals, such as nurses, the frequency is as high as 8%.

Latex is a form of sap extracted from rubber trees and is used in tires and rubber products of all kinds, especially protective gloves, which are used throughout the healthcare industry and other industries where materials must not be contaminated by touch. The milky latex sap contains hundreds of different proteins; more than 50

are allergenic. When these latex proteins interact with the skin, they can cause blisters and rashes. Latex proteins can also cause a reaction in the vagina, rectum, or urethra from using latex condoms or other contraceptive devices, or during medical exams.



Getting Rid of Dust Mites May Help Allergies

Dust mites are a major contributor to peoples' allergies. Strictly speaking, it is not the mites but their feces that are highly allergenic. Mites live by the millions in bedding, clothing, carpets, drapes, wall coverings, and upholstered furniture. They are particularly abundant in mattresses, pillows, blankets, quilts, and fuzzy animals.

Getting rid of dust mites is difficult. Because they burrow deeply into objects and are so tiny, vacuum cleaners usually do not remove them. Removal of such items as carpets, plush furniture, drapes, and other cloth from rooms is recommended. Encasing mattresses and pillows with hypoallergenic covers may help. Frequent washing of pillows, bedding, and clothes is recommended. Soaking bedding and clothes in one part liquid detergent to three parts eucalyptus oil for 30 minutes before washing removes 95% of mites and their debris. Try these steps if your allergies are severe.

The allergenic proteins in latex are similar to many proteins found in bananas, mangoes, papayas, cherries, peaches, avocados, milk, potatoes, and tomatoes. People who notice that they have become allergic to certain foods may, in fact, have become sensitive to latex. Physicians can test for latex allergies and can advise latex-sensitive people on what foods to avoid.

Asthma

Asthma is a chronic disease involving inflammation and narrowing of the airways of the respiratory system, rendering breathing difficult and occasionally nearly impossible. The inflammation and narrowing are caused by the tightening of muscles that surround the airways, the swelling of cells that line the airways, and the production of mucus. Asthma is often a reaction to inhaling a respiratory irritant such as cigarette smoke or cold air or a substance to which

someone is allergic. In susceptible individuals, exercise and stress also can trigger an *asthma attack*. Asthma sufferers are counseled to avoid situations and substances that trigger attacks. They also can use inhalers that contain drugs that alleviate an asthma attack or drugs that help prevent attacks from occurring. The most severe asthma attacks may require emergency medical intervention. Asthma affects people of all ages, but it most often starts in childhood. In the United States, 18.4 million people have asthma.

Although asthma attacks can be caused by both biological and environmental factors, they can also arise or be made worse by emotional upset and stress. Some asthmatic children often improve dramatically when separated from family situations that are stressful and emotionally upsetting. Adult asthmatics often notice that their attacks occur more frequently or become worse when they are upset or under stress that cannot be managed. Thus, asthmatics have an immunological makeup that makes them sensitive to allergens, but they also respond physically to emotions and stress in ways that other people do not.

The prevalence of asthma is increasing in the United States and worldwide. Scientists are unsure of the reasons for this increase, but certain risk factors have been identified, including a family history of allergy, low socioeconomic status, non-Caucasian ethnicity, male gender, age greater than 5 years, and exposure to industrial pollution, truck and car exhaust, tobacco smoke, dust, or cockroaches. The roles of maternal diet, breastfeeding, the time of introduction of baby foods, and the use of formulas in developing allergies have also been examined. There is no evidence that maternal diet or breastfeeding affects the risk of asthma.

One explanation for the increase in asthma is the *hygiene hypothesis*, which suggests that an extremely clean household environment can fail to provide the necessary exposure to germs required to “educate” the immune system to launch its defense responses to infectious organisms. Instead, immune defense responses are altered in ways that contribute to the development of asthma. The hygiene hypothesis is supported by observations that allergic diseases and asthma are more likely to occur when the

incidence and levels of certain allergens (bacterial lipopolysaccharide) in the home are low (U.S. Food and Drug Administration, 2017b). Several medications are available to manage asthma.

Food Allergies

Food allergies (not to be confused with *food intolerance*) are allergic responses to a particular food. The reaction can be local (such as vomiting, diarrhea, or abdominal cramps; pain and tightening of the throat; and trouble breathing), or it can involve the whole body (such as hives occurring over the entire body). Food allergies are most common in children but can occur in anyone at any age.

Six substances account for 90% of food allergies: eggs, peanuts, milk, fish, soy, and wheat. Severe allergic reactions produce **anaphylactic shock**, a systemic reaction that can quickly cause death. Anaphylactic shock can be brought on by an immediate, strong allergic reaction to food, a bee sting, or a drug. Approximately 400 deaths occur in the United States each year from anaphylactic shock.

Children are at particular risk of developing allergies to nuts, particularly peanuts. (Strictly speaking, the peanut is a legume, not a nut.) Children tend to outgrow most of their childhood allergies, but this is not true for an allergy to Brazil nuts, almonds, hazelnuts, and walnuts. Because the reactions in nut allergies can be quite serious, including anaphylactic shock, most people with nut allergies, including peanuts, have to be extremely careful because many manufactured products may contain trace amounts of nut residues. Peanut allergies are especially common and dangerous—some people suffer to such a serious degree that even a minuscule amount of peanut protein can lead to anaphylactic shock and death.

The FDA requires that all food labels list the presence of any of the eight most common food allergens. If even a trace amount of the allergen could be present, the food allergen still must be listed on the label. The eight most common food allergens, listed in order

according to the number of people affected, are: milk, egg, peanut, tree nut, wheat, soy, fish, and shellfish. More than 90% of all persons with food allergies test positive for one or more of these eight foods. Occasionally, people are also allergic to certain fruits and vegetables.

Recognition of “Self”

The immune system is able to recognize and destroy almost any foreign material, which is how it protects the body from infectious diseases. To prevent it from attacking the body's own cells, the immune system distinguishes cells of the body as *self* from foreign substances and other cells (even those of another person) that are *nonself*.

During fetal development, as the body's tissues are being formed, all of the antibody-producing cells that could attack the body's own cells are destroyed. It is not yet known how these particular antibody-producing cells are selected out of the millions of different cells and destroyed, but such a mechanism is vital to protect the organs and tissues of the body from destruction.

Autoimmune Diseases

The immune system must function without mistakes to distinguish *self* from *nonself* because any error that caused antibodies to attack the body's own cells could result in serious disease or death. Unfortunately, mistakes in the functioning of the immune system do occur and produce **autoimmune diseases** (**Figure 9.9**). Some inherited disorders, fortunately quite rare, can result in the loss of the immune system's ability to distinguish *self* from *nonself*. Environmental factors such as viral infections, nutritional problems, and other unknown agents may also cause the immune system to make mistakes that lead to autoimmune diseases.

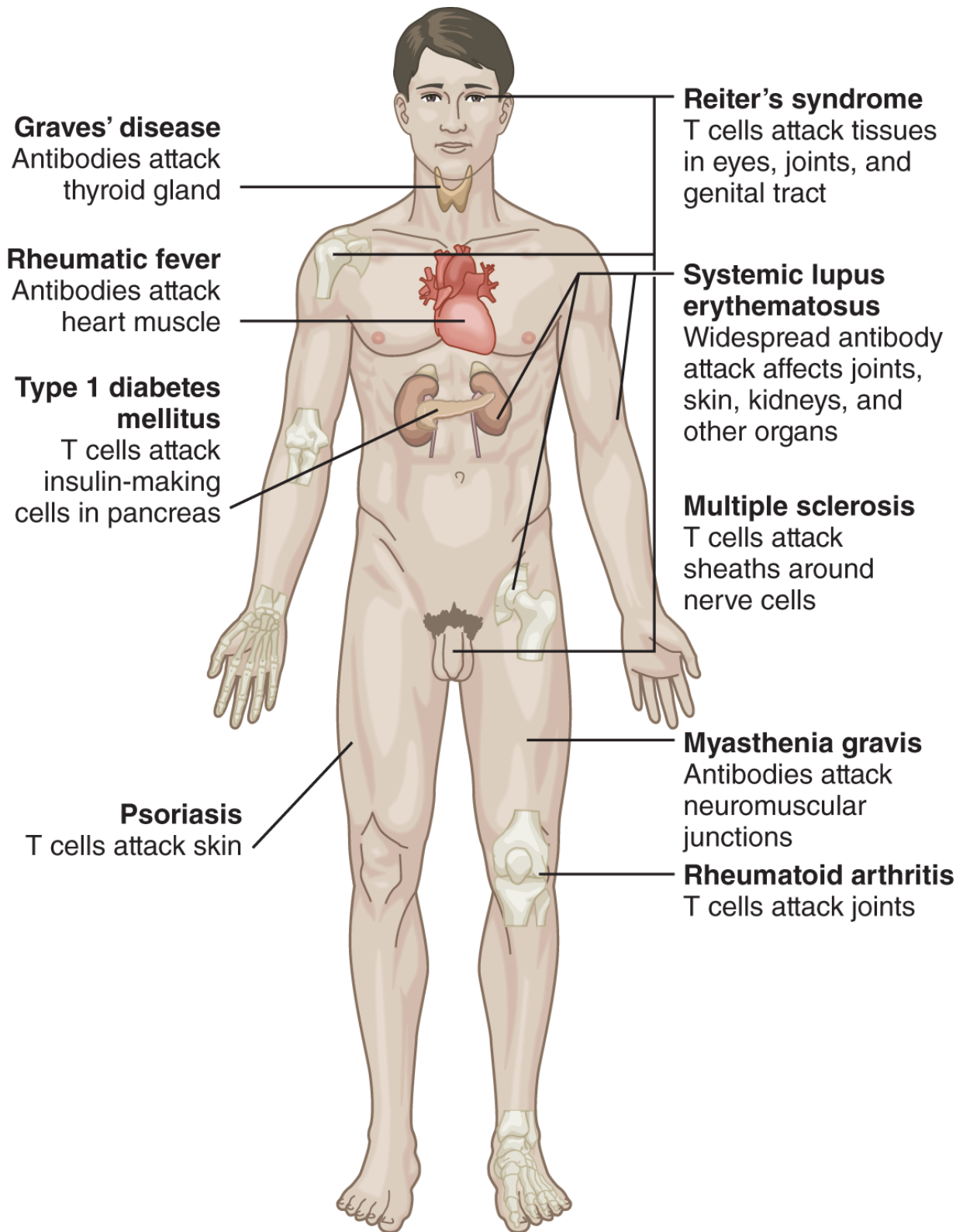


Figure 9.9 Autoimmune Diseases. These occur when the body's immune system goes awry and cells of the immune system begin attacking the body's own cells because they are

mistakenly recognized as foreign.

Description

A merry heart doeth good like medicine.

—Proverbs, 17:22

Some forms of **arthritis**, a chronic disease causing pain and stiffness in the joints, are autoimmune diseases in which the immune system mistakenly attacks cartilage and bone. Drugs can relieve some of the discomfort from autoimmune arthritis, but there is no cure.

Relaxation and visualization exercises that emphasize mobility and comfort can be of great benefit in relieving the pain, stiffness, and inflammation associated with arthritis. **Multiple sclerosis** is thought to be an autoimmune disease that affects the central nervous system by producing antibodies that attack **myelin**, a substance that sheathes and insulates nerve fibers in the brain and spinal cord.

Organ Transplants

Like blood cells, all body cells have antigens on their surfaces that are different for everyone except identical twins. If tissue or organs from one person are grafted onto another, the immune system produces antibodies to the foreign cell antigens, causing destruction of the cells and rejection of the transplanted organ.

The more alike two persons are genetically, the more likely it is that the transplanted tissue will be accepted by the recipient's body. Identical twins are genetically identical; this is why tissue transplants between identical twins have the greatest chance of success. To minimize the rejection of transplanted organs between nontwins, tests are performed to determine the degree of biological similarity between the cells of the donor and recipient. Just as red blood cells have particular groups of strongly antigenic proteins on their cell surfaces, so other cells in the body have antigenic proteins called

human leukocyte antigens (HLAs); these are crucial in determining whether a transplanted organ is accepted or rejected (**Figure 9.10**). The greater the similarity in HLA between donor and recipient, the greater the chance that the tissue will be accepted and function normally in its new host. The degree to which the antigens on cells of different persons are similar is called **histocompatibility**. There are so many different HLA combinations that each unrelated person is immunologically unique. People can wait months for suitable organs than can be supplied from living or deceased donors.

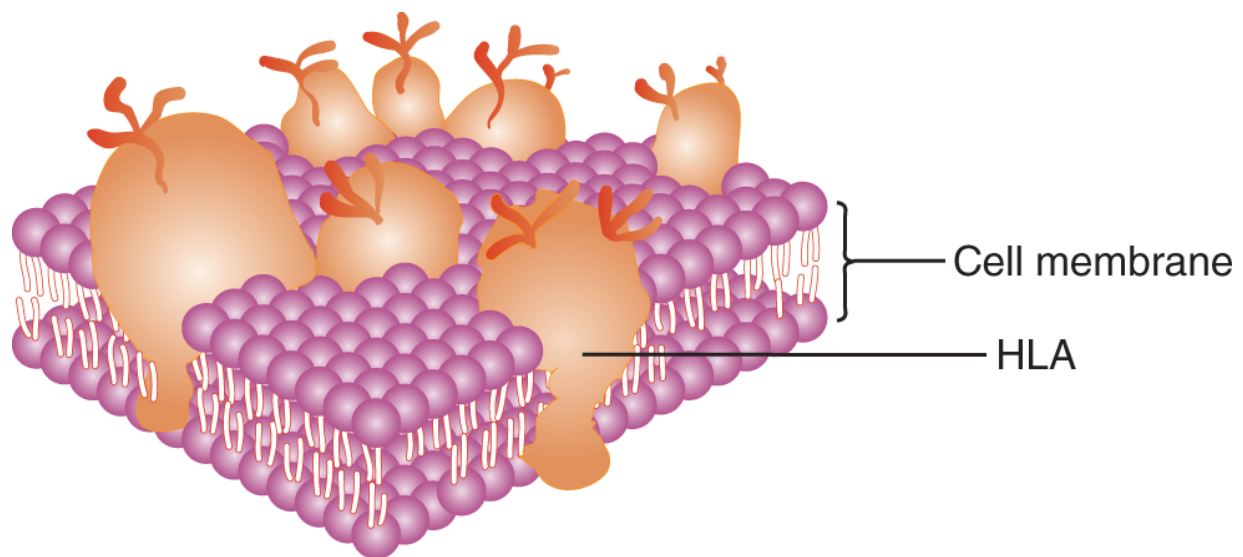


Figure 9.10 Antigens and the Immune System. A vast array of different HLAs is embedded in the outer membranes of cells, projecting beyond their surfaces. These antigens can be recognized by the body's immune cells and antibodies. Because every person's antigens are different, tissue transplanted from one person to another is usually rejected because the donor's HLAs are recognized as foreign and destroyed by the immune response of the recipient.

Description

The rejection of transplanted organs can be controlled to some degree with **immunosuppressive drugs** (corticosteroids, cyclosporine); however, treatment with these drugs lessens resistance to infections and sometimes enhances the development of other diseases. Long-term immunosuppressive drug therapy itself

results in increased susceptibility to cancer. It makes more sense to *prevent* kidney and heart diseases than to rely on surgical transplants.

Blood Transfusions: ABO and Rh Factors

In the early part of the 20th century, a blood transfusion often led to the patient’s death because the patient’s immune system recognized the donor’s blood cells as “foreign” and attacked them with both T cells and antibodies, impeding the flow of blood and oxygen and causing death.

The two most important human red blood cell surface antigens are the ABO and Rh-positive and Rh-negative proteins. **Table 9.3** shows the pattern of donor–recipient ABO blood types that must be matched for a successful transfusion.

TABLE 9.3 | Permissible Transfusions Determined by ABO Blood Group

Blood Group	Genotype	Antigens on Red Blood Cells	Transfusions Cannot Be Accepted From	Transfusions Are Accepted From
O (universal donor)	OO	None	A, B, AB	O
A	AA, AO	A	B, AB	A, O
B	BB, BO	B	A, AB	B, O
AB (universal recipient)	AB	A, B	None	A, B, AB, O

Description

People with type O blood have neither A nor B antigens on their red blood cells and are **universal donors**; their blood cells will not stimulate an antibody response in any recipient, no matter the blood type. People with type AB blood have both A and B antigens on their red blood cells. Thus, they do not manufacture antibodies to A or B blood cell antigens, and hence they are **universal recipients** who are able to accept blood of any ABO type.

The Rh-positive antigen and the antibody that reacts against it cause problems primarily in pregnancy. A woman is Rh-negative if her red blood cells do not contain any of this antigen. If the red blood cells of a developing fetus have the Rh-positive antigen (inherited from the father) and if some of the fetus's red blood cells enter the mother's blood supply, production of anti-Rh antibodies can be stimulated by her immune system, which recognizes the fetal cells as foreign. This usually does not cause any difficulty during the first pregnancy and might even go unnoticed until the woman becomes pregnant again.

Now, if the second fetus is also Rh-positive, the Rh-positive antibodies (synthesized during the first pregnancy) in the mother's blood attack the developing infant's red blood cells, resulting in anemia, brain damage, or even death. Fortunately, doctors can manage this problem safely and effectively. At the time the first child is delivered, the mother is given an injection of anti-Rh antibodies that destroys any Rh-positive antibodies in her blood. In this way, any danger to the fetus during a subsequent pregnancy is avoided.

Preventing Infections

To some degree, infections are unavoidable. However, healthy living can reduce the risk of contracting an infectious disease and also hasten recovery. Foremost is maintaining health by proper nutrition and a reasonable amount of exercise. These factors, as well as sufficient rest and sleep, increase the ability of the immune system to fight infectious organisms.

Vaccinations against certain infections can provide almost complete protection. Check your record of immunizations with your family physician and update any that have not been received on schedule or that you are not sure that you received as a child (see the Wellness Guide box, “My Vaccination Record”). Many infections, such as mumps or measles, that are usually mild in childhood can be serious if acquired as an adult.

Never forget that the mind interacts with the immune system and also contributes to the body’s propensity to ward off or to succumb to infections. Stressful situations and emotional upsets lower the body’s defenses and make it more vulnerable to infectious microorganisms. Finally, use common sense and stay away from people and situations that are known to carry a high risk of infection.

Critical Thinking About Health

1. A college student with a cold accidentally sneezes on her term paper as she prepares to hand it to her instructor. Explain how the instructor came down with a cold a couple of days later. Describe how the student and the instructor could have lessened the risk of transmission of this cold.
2. College health professionals were perplexed over the finding that three women students at three different universities in a far-distant state contracted a near-fatal abdominal infection presenting as severe stomach cramps, diarrhea, fever, nausea, and vomiting. Fearing spread of this infection, CDC scientists were called in to identify the cause of the mysterious infection and determine how the infection may have been acquired by the women in order to prevent its spread. Interviews with the three women revealed that each had traveled to a farming region in Europe during the previous summer, and each had developed there a fondness for a particular bottled fruit drink not available in the United States. Explain how spread of this potential infection was stopped.
3. Define *antibiotic resistance* and explain the reason it is a major public health concern. What could economically advanced countries do to lessen and even eliminate antibiotic resistance in medically important situations within the next 10 years?



My Vaccination Record

Directions

Make a record of your vaccinations using the accompanying chart.

Vaccine	Year Initial Series Completed	Years Revaccinated					
Diphtheria							
Hepatitis A							
Hepatitis B							
Influenza							
Measles							
Mumps							
Pertussis (whooping cough)							
Polio							
German measles (rubella)							
Tetanus							
Tuberculosis							
Other							

Description

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

The human body contains trillions of microorganisms, mostly bacteria, that are essential to normal body function and good health. The complete catalog of different microorganisms in and on a person's body is called the *human microbiome*. Everyone's microbiome has a different composition, and it plays a vital role in maintaining a person's health and resistance to disease. However, if microorganisms grow in regions of the body where they do not belong or if foreign microorganisms invade the body, disease may result. Viruses, bacteria, protozoa, fungi, worms, and insects can all infect the human body and cause disease. Some disease-causing organisms are passed from person to person and can spread rapidly in a population, causing an epidemic or a pandemic if the infection spreads worldwide. Fortunately, the body has several lines of defense against diseases-causing organisms. The immune system produces a variety of cells and proteins that recognize foreign organisms and foreign cells that enter the body and destroy them. But some microorganisms have evolved mechanisms that help them avoid attack by the immune system's defenses. The human immunodeficiency virus, the cause of AIDS, is one such virus that can avoid eradication by the immune system.

Immunization refers to injection of substances that prime the immune system to immediately attack specific disease-causing viruses and bacteria should a person encounter them. Immunizations are the safest and most effective way to prevent serious diseases such as mumps, measles, polio, flu, pneumonia, cervical cancer, hepatitis, and others. Sometimes the body's immune system recognizes certain proteins as harmful when they are, in fact, harmless. This produces symptoms of allergy—sneezing, coughing, headache, vomiting, diarrhea, even death from shock. Every person carries a unique set of proteins on their cells that distinguishes one

person from another. Transplant of organs or blood transfusions from one person to another depends on matching certain key proteins between donors and recipients of blood or tissues. Long-term use of drugs helps prevent rejection of a transplanted organ by the recipient's immune system.

HIGHLIGHTS

- Infectious diseases are caused by a myriad of pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms. Growth of certain microorganisms in the body can cause a wide range of diseases and sickness; some produce only mild symptoms, but others produce serious disease and death.
- Some pathogenic microorganisms are easily passed from one person to another and cause communicable diseases.
- Some infectious diseases are caused by a vector, such as an insect or other animal, that transmits the pathogenic microorganism to an uninfected person.
- Antibiotics kill microorganisms but do not kill viruses, which are not alive in the sense that cells are.
- Infectious disease is fought in four ways: keeping infectious organisms out of the body, personal cleanliness and sanitation, antibiotics, and vaccination.
- Vaccinations are vital to preventing serious infections. Approved vaccines are safe except in rare cases of adverse reactions.
- The skin and mucus membranes keep harmful substances from entering the body.

- Specialized white blood cells circulate in the body, attacking and destroying invading foreign organisms.
- The immune system produces cells that make antibodies, which are proteins that recognize any foreign substance or organism.
- Malfunctioning of the immune system causes autoimmune diseases and allergies.
- Each person carries a unique set of antigens on cells of the body that make tissues and organs unique to each individual.
- Transplantation of organs or blood requires that the donor and recipient be matched as much as possible with respect to HLA or ABO antigens.

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KEY TERMS

infection:

the entry, survival, and reproduction of nonself-organisms in one's body

infectious disease:

a disease caused by a parasite

pathogen:

a disease-causing organism

communicable disease:

an infectious disease that is usually transmitted from person to person

human immunodeficiency virus (HIV):

the virus that causes AIDS

acquired immune deficiency syndrome (AIDS):

a syndrome of more than two dozen diseases caused by HIV

vector:

the carrier of infectious organisms from animals to people or from person to person

tuberculosis (TB):

a serious lung infection caused by the bacterium *Mycobacterium tuberculosis*

human microbiome:

the total composition of bacteria, fungi, viruses, and other microorganisms that inhabit a human body

emerging infectious diseases:

infections that newly appear, or reemerge, within a vulnerable population of people or known infections that are suddenly

spreading rapidly.

immunizations:

vaccinations to prevent a variety of serious diseases caused by both bacteria and viruses

leukocytes:

white blood cells that fight infections

macrophages:

specialized cells that destroy and eliminate foreign particles and microorganisms from the body

penicillin:

an antibiotic produced by mold and capable of curing many bacterial infections

antibiotics:

antibiotics (antimicrobials): chemicals that prevent infecting organisms from causing disease

immune system:

an interacting system of organs and cells that protect the body from infectious organisms and harmful substances

lymphatic system:

a system of vessels in the body that trap foreign organisms and particles; the immune system is part of the lymphatic system

lymph nodes:

nodules spaced along the lymphatic vessels that trap infectious organisms or foreign particles

T cells:

cells of the immune system that attack foreign organisms that infect the body

cell-mediated immunity:

the response of T cells to infections

B cells:

cells of the immune system that produce antibodies

humoral immunity:

the response of B cells to infections

antibodies:

proteins that recognize and inactivate viruses, bacteria, and other organisms and toxic substances that enter the body

antigens:

foreign proteins on infectious organisms that stimulate an antibody response

cytokines:

small molecules that coordinate the activities of B cells and T cells

vaccination:

the administration, usually by injection (hence the name “shot”), of substances called vaccines

vaccines:

inactivated bacteria or viruses that are injected or taken orally; the body responds by producing antibodies and cells that provide lasting immunity

allergens:

foreign substances that trigger an allergic response by the immune system

histamine:

a chemical released by cells in an allergic response; causes inflammation

contact dermatitis:

an allergic reaction of the skin to something that is touched

asthma:

a chronic disease involving inflammation and narrowing of the airways that makes it difficult to breathe

food allergies:

allergic responses to something that is eaten

anaphylactic shock:

a severe allergic reaction involving the whole body that can cause death

autoimmune diseases:

mistakes in the functioning of the immune system that cause it to attack tissues in the body

arthritis:

a variety of chronic diseases involving inflammation, stiffness, and pain in joints of the body

multiple sclerosis:

an autoimmune disease that affects the central nervous system

myelin:

a substance that sheathes and insulates nerve fibers in the brain and spinal cord

human leukocyte antigens (HLAs):

antigens that are measured to determine the suitability of an organ for transplantation from donor to recipient

histocompatibility:

the degree to which the antigens on cells of different persons are similar

immunosuppressive drugs:

drugs to suppress the functions of the immune system (e.g.,
after organ transplants)

universal donors:

people whose blood is accepted by everyone during transfusion

universal recipients:

people whose blood type is compatible with anyone else's blood



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CHAPTER 10

Cardiovascular Diseases: Understanding Risks and Measures of Prevention



Health Tips

Infected Gums Contribute to Heart Disease

Cardiovascular Fitness: Exercise Your Heart



Global Wellness

It's Not Too Late to Have a Healthy Heart



Wellness Guide

How to Interpret Blood Cholesterol and Lipid Measurements

Concussion to the Heart

Self-Care: Hand on Heart Exercise

Genes May or May Not Increase the Risk of Heart Disease

LEARNING OBJECTIVES

1. Define cardiovascular disease and provide three examples.
2. Describe how blood flows through the heart and blood vessels.
3. Describe two types of cardiac arrhythmia.
4. Describe how the direction of blood flow in the body is regulated.
5. Define atherosclerosis and explain its treatment with statins.
6. Describe coronary heart disease and the available treatments.
7. Define stroke, hypertension, and metabolic syndrome.
8. List three lifestyle factors that increase the risk of cardiovascular disease.

The human heart has long been a symbol of human love as it is expressed in poetry, stories, and everyday customs. Our language still reflects the idea that love and feelings reside in the heart. The word *heartfelt* implies deep feelings of caring and sincerity; *heartless*, however, implies being cold and uncaring. When love relationships collapse, people refer to their *broken hearts* or the *heartlessness* of the former lover. People are described by the nature of their hearts—cruel, kind, warm, or cold; some are even

referred to as having a heart of stone. When people refer to distressing experiences in life, they talk of *heartache*, and when they are happy, their hearts may “leap with joy.”

Love at first sight saves a lot of time and money.

—Evan Esar

Today we know that emotions, thoughts, and feelings of every kind originate in the brain, not the heart. The heart's only function is to pump blood and circulate it throughout the body. The heart is an extraordinarily effective pump; it pumps slightly more than a gallon of blood per minute through approximately 60,000 miles of blood vessels in the body. In this gallon of blood are about 25 trillion red blood cells that carry oxygen from the lungs to all the body's cells and remove the carbon dioxide that is exhaled as waste. Each day about 200 billion new red blood cells are synthesized in bone marrow (the soft material at the center of large bones) and released into the circulation. Each day the heart expands and contracts (beats) 100,000 times and pumps about 2,000 gallons of blood. A healthy heart and blood vessels are essential for survival.

The heart works so hard that it's a wonder that it can do so for so long in so many people. However, the heart is not invincible. It can be weakened by infection, injury, birth malformations, and damage resulting from its owner's behavior, such as consuming a poor diet, not engaging in enough physical activity, and tobacco smoking.

The American Heart Association in conjunction with the Centers for Disease Control and Prevention, the National Institutes of Health, and other government agencies has identified core behaviors that can greatly enhance heart health when implemented (**Figure 10.1**). Discussion of these and other facets of cardiovascular health is the purpose of this chapter.

- Eat healthy especially fruits, vegetables, legumes, nuts, seeds, and whole grains
- Sit less, move your body, take a walk
- No tobacco smoking
- Maintain healthy blood pressure
- Go easy on fats and cholesterol
- Go easy on sugar
- Go easy on alcohol
- Maintain a healthy body weight
- Take time outs to ease your mind
- Relax, have fun, be social



Figure 10.1 Core Behaviors for a Healthy Heart.

Data from American Heart Association (http://www.heart.org/HEARTORG/Conditions/MyLife-Check/Life-Simple-7_UCM_471053_Article.jsp#.Wc6NRGJSzfY); U.S. Centers for Disease Control (https://www.cdc.gov/heartdisease/what_you_can_do.htm); Harvard Medical School (<https://www.health.harvard.edu/topics/heart-health>); University of Wisconsin (<http://www.uwhealth.org/heart-cardiovascular/health-psychology-for-healthy-hearts/38645>)

Description

Cardiovascular Diseases

Cardiovascular disease (CVD) refers to any number of conditions that damage the heart (*cardio*) and blood vessels (*vascular*) (see **Table 10.1**). According to the World Health Organization (2017), cardiovascular disease is the number one cause of death worldwide, accounting for about 31% of all deaths; about 18 million people die of cardiovascular disease annually. In the United States, cardiovascular disease is the leading cause of death, accounting for more than 650,000 annual deaths (U.S. Centers for Disease Control and Prevention, 2021a). Some cardiovascular diseases stem from biological malformations present at birth (*congenital heart disease*), bacterial infections of the heart (**rheumatic heart disease**) and its surrounding tissues (*pericarditis*), and injury. Others occur in association with other diseases (e.g., high blood pressure and type 2 diabetes). But by far the most prevalent cardiovascular disease in the United States, and the one that is most amenable to prevention, is **coronary heart disease (CHD)**, the result of fatty deposits (called **plaque**) in the heart's coronary arteries that impede or completely block the transport of oxygen and nutrients to the heart muscle cells, resulting in a **heart attack**. Stroke, or brain attack, is the second most frequent cardiovascular disease. A stroke occurs when sufficient blood does not reach brain cells and they die.

TABLE 10.1 Categories of Cardiovascular Disease	
Disease	Description
Cerebrovascular disease	Disease of the blood vessels supplying the brain; common cause of stroke
Congenital heart disease	Malformations of heart structure existing at birth

Disease	Description
Congestive heart failure	Weakening of the heart muscle making it unable to pump blood efficiently or at all
Coronary heart disease	Disease of the blood vessels supplying the heart muscle
Deep vein thrombosis	Blood clots in the leg veins, which can dislodge and move to the heart, lungs, and brain
High blood pressure	Weakens the heart and damages blood vessels
Peripheral arterial disease	Disease of blood vessels supplying the arms and legs
Pulmonary embolism	Blood clots that lodge in the lungs and block blood flow to the heart
Rheumatic heart disease	Damage to the heart muscle and heart valves from rheumatic fever; caused by streptococcal bacteria

The incidence of death from cardiovascular diseases among Americans has been declining steadily in recent decades (**Figure 10.2**). One major reason for this trend is that more and more people have become aware that most cardiovascular disease is preventable by adopting healthy living habits such as eating healthfully, engaging in moderate physical activity on most days of the week, not smoking tobacco, and maintaining a normal **blood pressure** and body weight. Another major reason for the decrease in the incidence of death from cardiovascular disease is the recent and continued development of effective surgical, medical, and psychological treatments for several of these diseases.

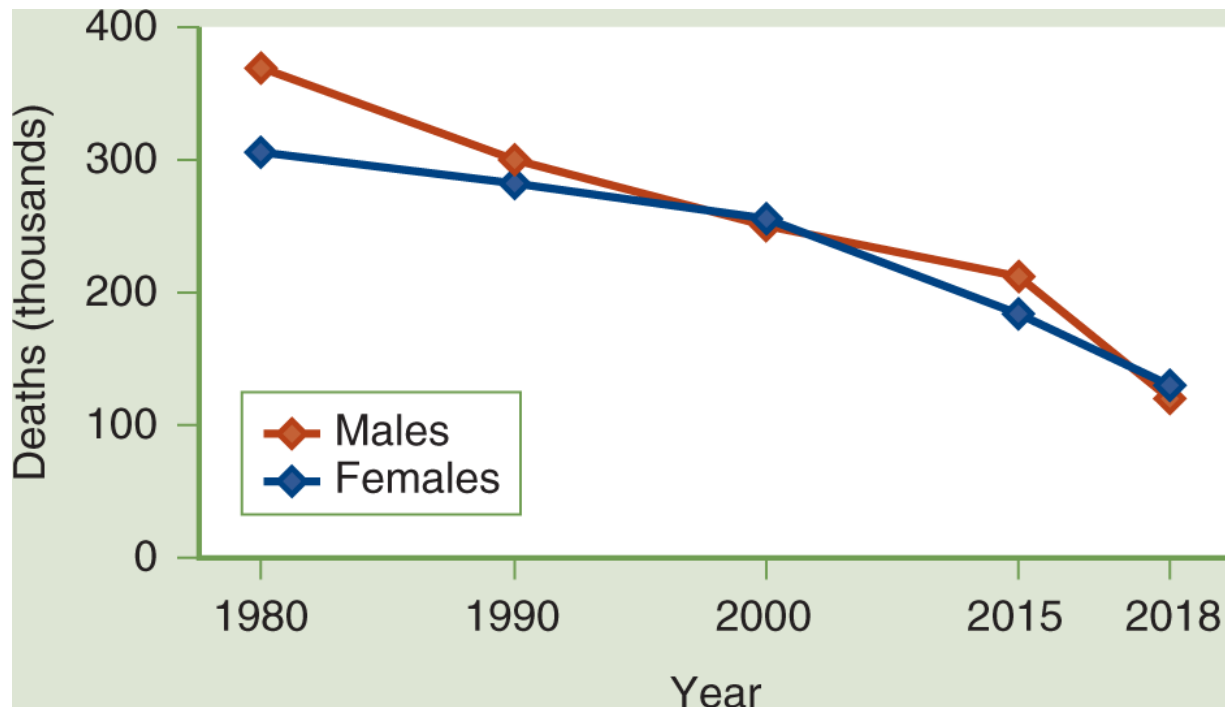


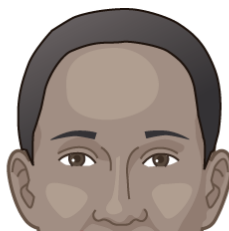
Figure 10.2 Mortality from Cardiovascular Disease in the United States (1980–2018).

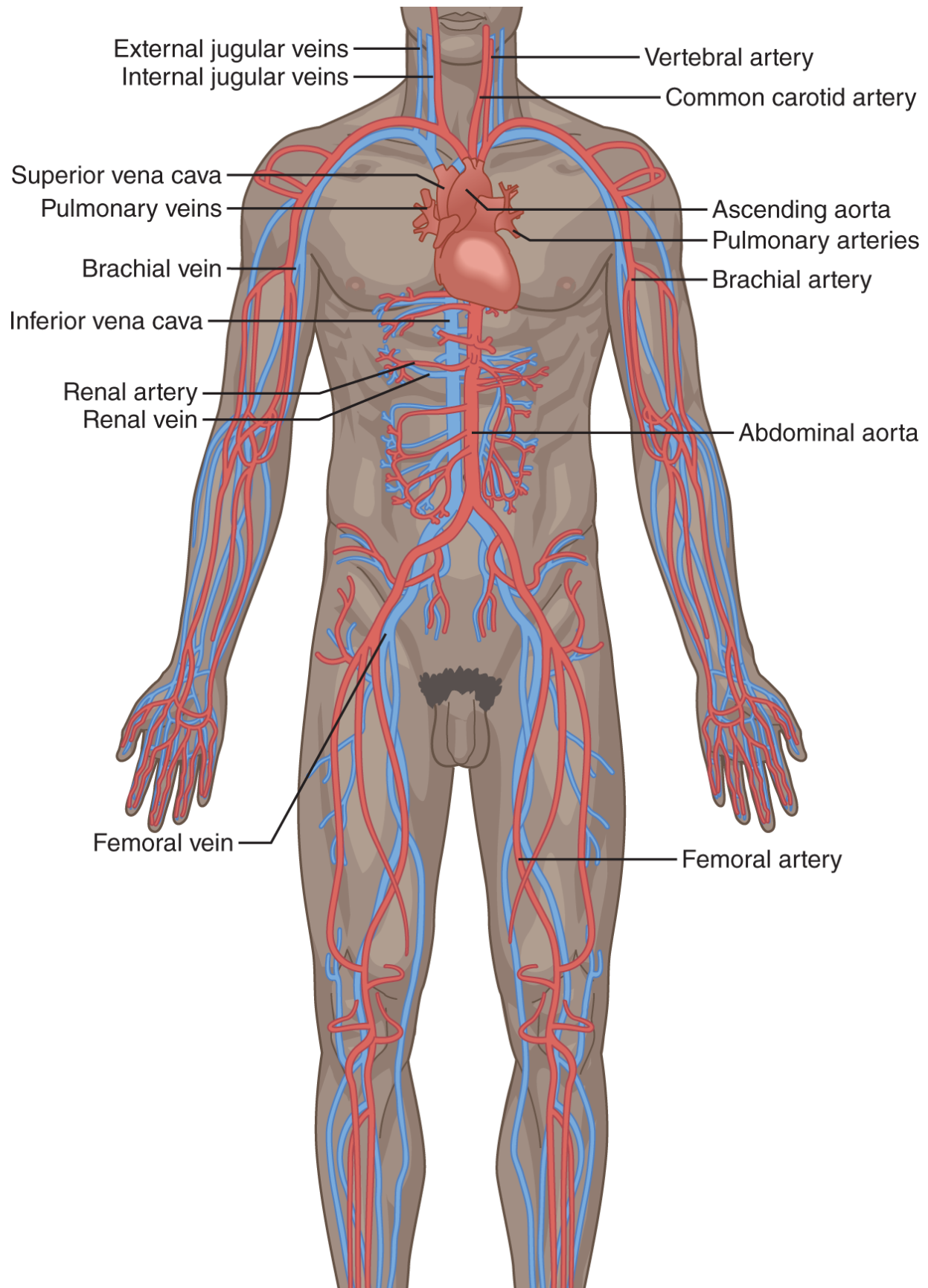
Data from National Center for Health Statistics

Description

The Heart and Blood Vessels

The human cardiovascular system consists of the heart (the pump) and the various blood vessels (**Figure 10.3**). **Arteries** carry oxygenated blood from the heart to all organs and tissues in the body. **Veins** return blood to the heart after oxygen and nutrients have been exchanged for carbon dioxide and waste products. **Capillaries** are tiny blood vessels that branch out from arteries to circulate blood to all of the cells in the body. Blood vessels can be damaged by injury or by disease; this damage may obstruct the flow of blood carrying oxygen and nutrients.





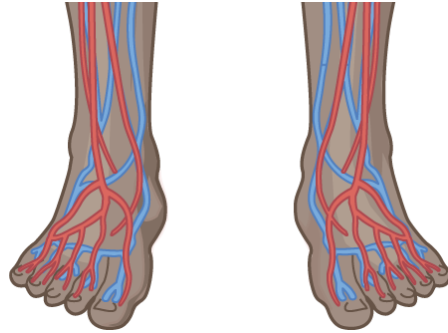


Figure 10.3 Cardiovascular System. The cardiovascular system includes the heart, arteries, and veins. The heart receives oxygenated blood from the lungs and pumps it to all tissues in the body.

Description

The organ that keeps the blood circulating throughout the body is the heart, a highly specialized muscle about the size of an adult fist that pumps blood (**Figure 10.4**). The muscular wall of the heart is called the **myocardium**. When the blood supply to heart cells is blocked, they begin to die and a heart attack results.

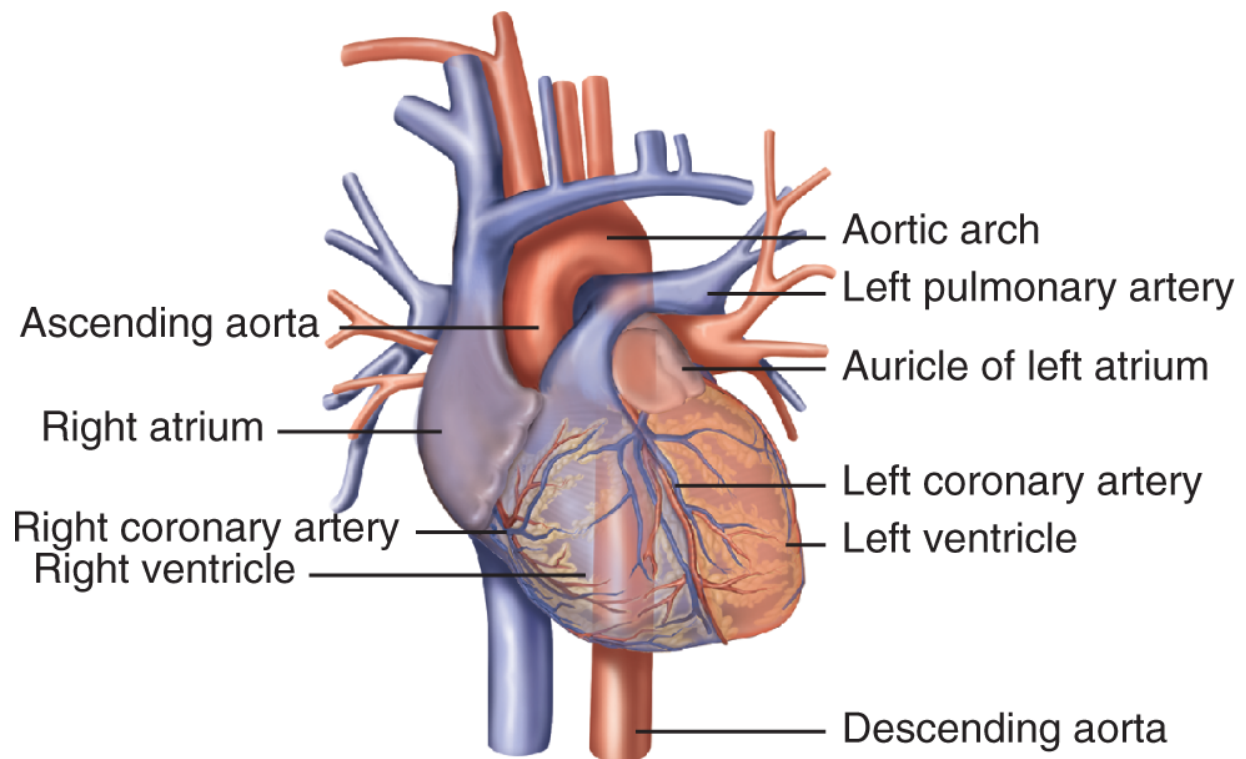


Figure 10.4 Heart and Major Arteries. Oxygenated blood is pumped through the arteries (red), and oxygen-depleted blood is returned to the heart via the veins (blue).

Description

The heart consists of four separate chambers: The two upper chambers are called the *left atrium* and the *right atrium*; the lower two chambers are the *right ventricle* and the *left ventricle*. Blood that is depleted of oxygen enters the heart via the right atrium and then flows to the right ventricle. From there blood is pumped to the lungs, where it is reoxygenated and returned via the pulmonary veins to the left atrium. Finally, the oxygen-rich blood is pumped throughout the body's tissues from the left ventricle through the large artery called the **aorta**.

The Heart Beat

The heart contracts from 60 to 100 times a minute, depending on the body's level of activity or excitement. The entire volume of blood in the body is recirculated almost once every minute. During a lifetime of 70 years, the heart will pump between 30 million and 40 million gallons of blood, and it will beat 2.5 billion times!

The beat of a healthy heart is characterized by its rate and its pattern, or *rhythm*. The heart rate is the number of times per minute the lower chambers of the heart (the ventricles) contract to move blood out of the heart. The heart rhythm is a sequence of coordinated biological events that create ventricular contractions strong enough to move blood.

An **electrocardiogram (EKG)**, also called an ECG or EKG, is a simple, painless test that can show how fast the heart is beating and whether the rhythm of the heartbeats is steady or irregular (**Figure 10.5**). An EKG is often part of a routine exam to screen for heart disease, and it is also used to detect and assess heart problems such as heart attacks, arrhythmias (i.e., irregular heartbeat), and **heart failure**. Results from this test also may suggest other heart disorders.

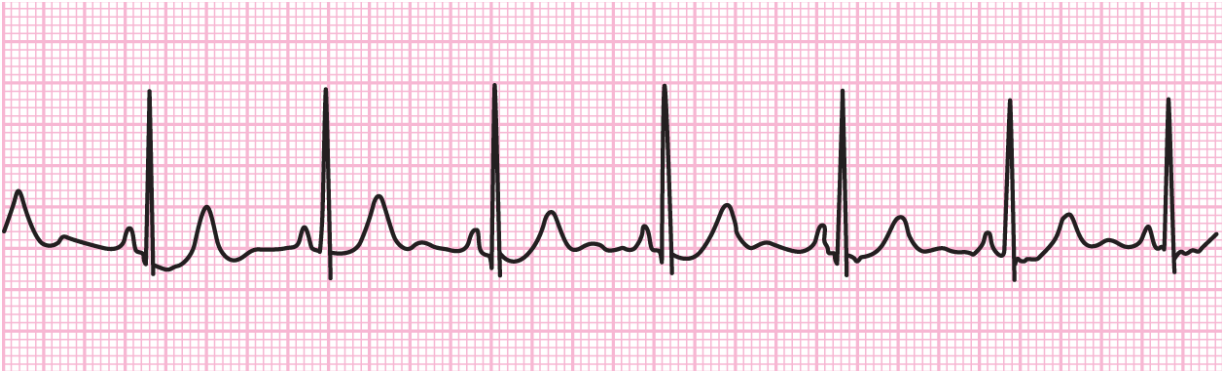


Figure 10.5 Electrocardiogram. This electrocardiogram (EKG) is a graphical depiction of normal electrical activity of the heart. The tall spikes represent the contraction of the ventricles (“the pulse”), which send blood out of the heart into the circulation. Notice how the pulses occur at regular intervals, about 41 small squares per heartbeat. The smaller bump at the left of the ventricle spike represents the contractions of the atria. The small bump at the right of the ventricle spike represents the ventricles preparing to contract. Each large square represents 0.2 seconds, so this heart is beating once just about every 0.8 seconds. Can you calculate the heart rate per minute?

The heart rate is controlled by a region in the right atrium called the **sinoatrial node**. This region sends electrical signals across the surface of the heart, which causes heart muscle fibers to contract as a group so blood moves smoothly through the heart. The sinoatrial node’s control of the heart rate is also influenced by electrical signals from the brain via the autonomic nervous system and certain hormones (e.g., adrenalin) in response to varying conditions such as exercise, warm body temperature, excitement, stress, and fear.

A biological anomaly, injury, or disease can cause the heartbeat to lose its normal rhythmic pattern. An irregular heartbeat is called an *arrhythmia*. Symptoms of arrhythmias include a fast or slow heartbeat, skipping beats, shortness of breath, chest pain, lightheadedness, dizziness, and sweating. Types of arrhythmias are presented in **Table 10.2**.

TABLE 10.2	Types of Irregular Heart Rhythms
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Type	Description
Premature (extra) beats	A sensation of fluttering in the chest or a skipped beat. Common issue; most of the time requires no treatment, especially in healthy people. Premature beats in the atria are called <i>premature atrial contractions</i> (PACs). Premature beats in the ventricles are called <i>premature ventricular contractions</i> (PVCs).
Atrial fibrillation (AF)	A rapid, irregular contraction of the atria resulting from abnormal electrical signals coursing in a disorganized way through the heart tissue. This causes the walls of the atria to quiver (fibrillate) so that blood is not pumped in the normal way. Stroke and heart failure are serious complications of ongoing, untreated AF.
Atrial flutter	Similar to atrial fibrillation; the spread of electrical signals through the atria is too fast and regular (as opposed to irregular). Similar symptoms and complications as atrial fibrillation.
Paroxysmal supraventricular tachycardia (PSVT)	A rapid heart rate that begins and ends suddenly. It occurs because of problems with the electrical connection between the atria and the ventricles. Not usually dangerous; tends to occur in young people. It can happen during vigorous exercise.
Ventricular tachycardia	A fast, regular beating of the ventricles. A few beats of ventricular tachycardia often do not cause problems, but episodes lasting for more than a few seconds can be dangerous.
Ventricular fibrillation	Disorganized electrical signals make the ventricles quiver instead of pump normally. When ventricles do not pump blood out of the heart, a person will lose consciousness within seconds and may die. To prevent death, the condition must be treated immediately with defibrillation, an electric shock to the heart.
Bradyarrhythmias	The heart rate is much slower than normal. An excessively slow heart rate may result in not enough blood reaching the brain.

In addition to the sinoatrial node, the heartbeat also can be affected by nerve impulses that originate in various areas of the heart. If these signals interfere with the normal heartbeat, different areas of the heart will beat independently of one another. The result is **atrial fibrillation (“a-fib”)**, which are rapid, disorganized contractions of the upper chambers of the heart. This can cause

blood to pool in the atria instead of being pumped into the heart's two lower chambers, the ventricles. Thus, the heart's upper and lower chambers don't work in a coordinated fashion and blood flow throughout the body is impaired.

My entire politics is premised on the fact that we are these tiny organisms on this little speck floating in the middle of space. We're just a bunch of humans with doubts and confusion. We do the best we can. And the best thing we can do is treat each other better, because we're all we got

—**Former President Barak Obama.** New York Times interview, 2021

A-fib usually develops as people age; it is estimated that nearly 3 million Americans experience atrial fibrillation to some degree. Usually, the episodes are brief and no ill effects are noticed. In some instances, however, atrial fibrillation can cause a stroke. This can occur when irregular heartbeats slow the flow of blood in the heart to the extent that clots form. A blood clot that travels through the bloodstream to the brain can cause a stroke.

Atrial fibrillation can be managed with various drugs, and anyone who experiences an irregular heartbeat (usually noticed as a palpitation in the chest) should see a physician. If the fibrillation cannot be controlled with drugs, a **pacemaker** can be implanted in a person's chest. This is a small electrical device that supplies a steadying electrical signal to the heart.

Ventricular fibrillation (“v-fib”) is a type of cardiac arrhythmia in which the ventricles (the lower chambers of the heart) quiver rapidly and irregularly instead of contracting forcefully, resulting in the heart pumping little or no blood to the body. V-fib can be fatal if the heartbeat is not restored within a few minutes (*sudden cardiac arrest*). Certain diseases and conditions can cause problems with the ventricular heart rhythm, including coronary heart disease,

physical stress, certain inherited disorders, and structural changes in the heart from high blood pressure. About 300,000 out-of-hospital cardiac arrests occur in the United States each year.

A **defibrillator** is an electrical device that can restore normal heart rhythm by delivering electrical shocks through the chest to the heart. For a heart attack victim to survive, defibrillation should be initiated within a short period (a few minutes) after the beginning of the heart attack. By the time a patient reaches an emergency room, it is often too late for defibrillation.

For these reasons, *automated external defibrillators* (AEDs) have been developed and are now placed in many public areas where people congregate, such as shopping malls, sports arenas, stadiums, and airplanes. AEDs also can be purchased by individuals and kept in the home, where about 80% of heart attacks occur.

People who experience frequent abnormal heart rhythms (cardiac arrhythmias) may be candidates for an *implantable cardioverter defibrillator* (ICD) (**Figure 10.6**). A small unit is implanted in the chest with wires attached to the heart. If the heart begins to beat irregularly, the defibrillator will deliver a pulse of electricity to the heart to restore normal heartbeats. Each year in the United States, about 100,000 patients receive an ICD at a cost of \$30,000 to \$50,000 per patient. The batteries last about 5 years; then, the surgery must be repeated. Most patients with ICDs will not experience an arrhythmia severe enough to trigger an electrical shock. But doctors still cannot distinguish with certainty those patients who definitely need an ICD from those who probably do not.

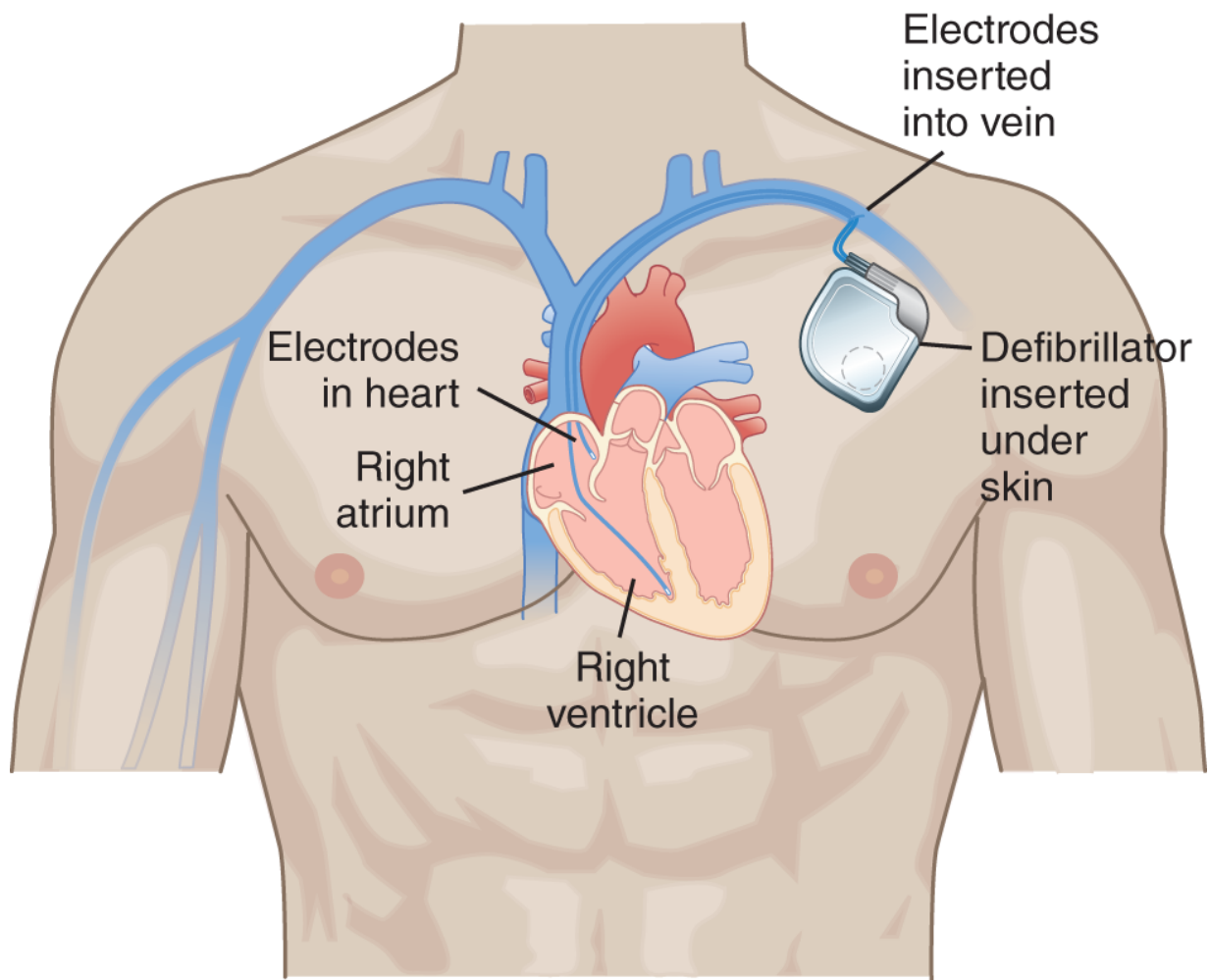


Figure 10.6 A defibrillator is a small metal box containing a battery, a computerized generator, and wires with sensors at their tips. The sensors detect the heart rate and rhythm and send data through the wires to the computer in the generator. If the heart rhythm is abnormal, the computer will direct the generator to send electrical pulses through the wires to regulate the heart. Pacemakers have one to three wires that are each placed in different chambers of the heart. The wires in a single-chamber pacemaker usually carry pulses from the generator to the right ventricle (the lower right chamber of your heart). The wires in a dual-chamber pacemaker carry pulses from the generator to the right atrium (the upper right chamber of your heart) and the right ventricle. The pulses help coordinate the timing of these two chambers' contractions. The wires in a biventricular pacemaker carry pulses from the generator to an atrium and both ventricles. The pulses help coordinate electrical signaling between the two ventricles. This type of pacemaker also is called a *cardiac resynchronization therapy device*.

Data from U.S. National Heart, Lung, and Blood Institute
(<https://www.nhlbi.nih.gov/health/health-topics/topics/pace/howdoes>)

Description

Regulating Blood Flow

To maintain uniform blood flow in the correct direction, the cardiovascular system is equipped with one-way valves in both the chambers of the heart and blood vessels (**Figure 10.7**). With every heartbeat, the valves in the heart open and close to allow blood to move in one direction. In rare cases, one or more of the heart valves may be defective at birth because of developmental abnormalities. With modern techniques of **open-heart surgery**, defective heart valves can be repaired or replaced with artificial valves that allow the heart to function normally.

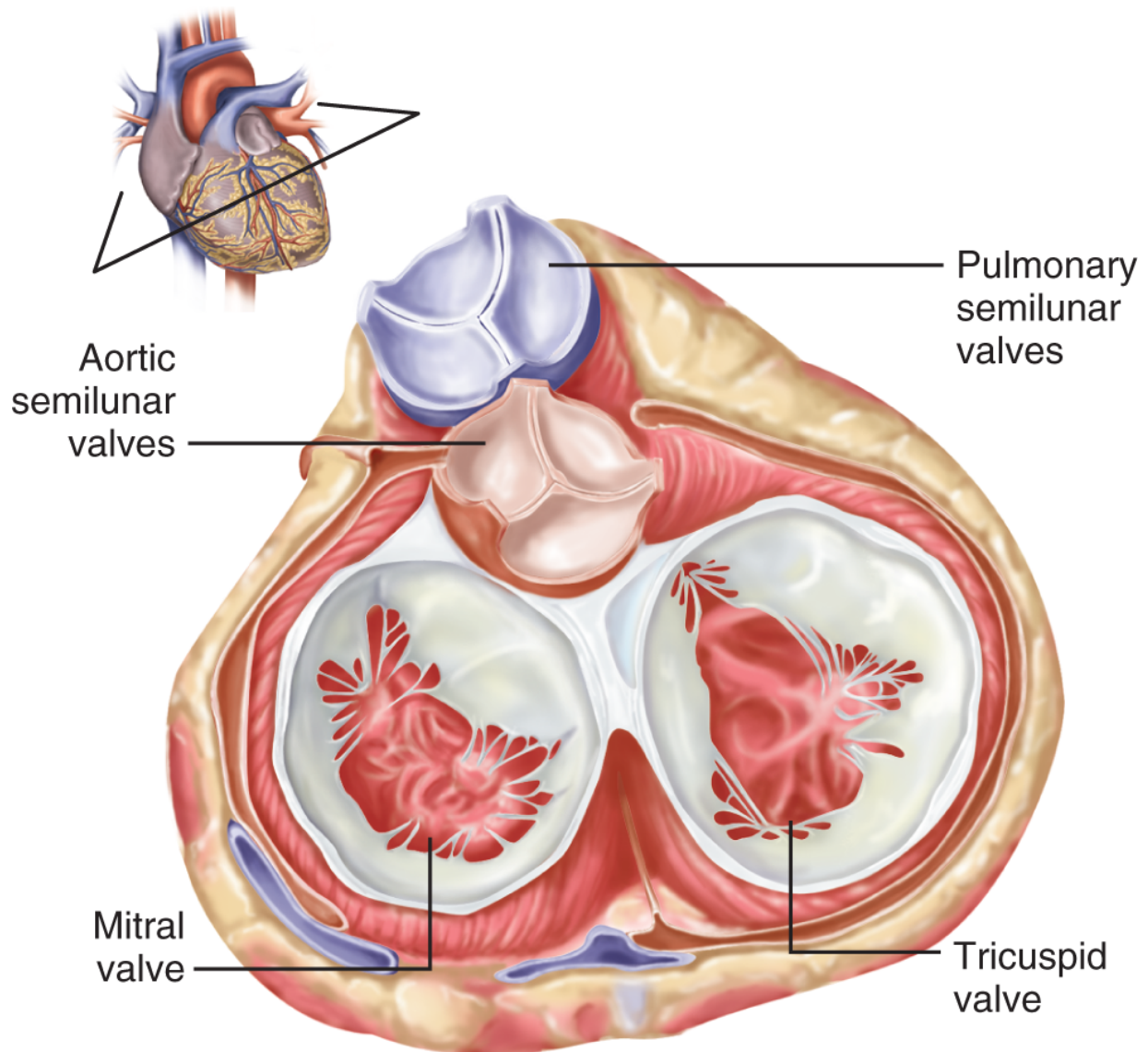


Figure 10.7 Heart Valves. The heart's valves keep the blood flowing in one direction into and out of the chambers of the heart.

Description

Rheumatic Heart Disease

Heart valves can also be damaged by childhood throat infections caused by *Streptococcus* bacteria. Repeated streptococcal infections can cause rheumatic heart disease (formerly called *rheumatic fever*), a serious inflammatory disease of the heart valves. In susceptible people, the immune system overreacts to the presence of the bacteria. Some proteins on the heart cells are similar

in structure to proteins on the bacteria, so the immune system attacks heart valve cells as well as the infectious bacteria.

The mitral and aortic valves are particularly susceptible to damage by infections. Scar tissue forms and prevents the valves from opening and closing correctly. By listening to the heartbeat, a **cardiologist**, a physician who specializes in heart diseases, can detect abnormalities in the heart's valves. Because of potential heart problems, it is important that all “strep throat” in children be treated with antibiotics to reduce the risk of developing rheumatic heart disease.

A loving heart is the beginning of all knowledge.

—**Thomas Carlyle**, 19th-century English writer, philosopher, and historian

Varicose Veins

Another common but less serious condition affecting the valves in the veins is **varicose veins**. These appear as bluish bulges in veins, usually in the legs. Blood returning to the heart from the legs has to flow against the pull of gravity, and one-way valves in the veins normally prevent the blood from draining downward. If the valves in the veins of the legs become weakened, blood tends to accumulate, distending the veins and producing visible varicose veins. The valve failures in the veins are not life-threatening and often can be corrected by surgical removal of the damaged areas.

Heart Failure

Heart failure (sometimes called *congestive heart failure*) is a condition of a heart too weakened by arrhythmia or other heart disease to pump sufficient blood throughout the body, even after the application of surgical and medical interventions. In this case, a person experiences fatigue, diminished movement capacity,

shortness of breath, and swelling (edema). The treatment for heart failure is a heart transplant. This involves being put on a waiting list and hoping that a suitable donor can be found among people who have died suddenly, such as victims of car accidents. The person with a failing heart must live and wait near a hospital where heart transplant surgeries are performed. If a suitable heart becomes available following a person's death, the donor's heart is removed and rushed to the recipient's hospital by a special medical team. Heart transplants are complex, costly, and not always successful. Still, about 2,000 heart transplants are performed in the United States each year. About 50% of heart recipients experience rejection of the new heart within the first year. All recipients must take immune-suppressive drugs for life to help prevent rejection of the transplanted heart by their own body's defenses.

Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation (CPR) is hands-on emergency procedure administered to a person who has stopped breathing (e.g., near drowning), whose heart has suddenly stopped beating (sudden cardiac arrest), or who has had a heart attack and whose heart stops beating. Note that sudden cardiac arrest and heart attack are not the same. A sudden heart attack occurs because the heart chambers are not beating in rhythm; heart attack is the result of the death of heart muscle. In either case, the heart become unable to pump blood throughout the body. Signs of cardiac arrest include an absence of heartbeats, blood flow, and pulse. When blood stops flowing to the brain, the person becomes unconscious and stops regular breathing.

CPR involves two actions by the person administering it: (1) mouth-to-mouth breathing and (2) repeated, rapid, and vigorous compression of the chest. Chest compressions force blood to circulate, which is critical to supplying vital organs and the brain with the oxygen remaining in the blood. Studies have shown that people who take a CPR training course can learn how to use a defibrillator in about 5 minutes and CPR in about 20 minutes.

Automated external defibrillators are portable electronic devices that can administer a small electric shock to someone whose heart has stopped. AEDs are increasingly found in public places such as shopping malls, airports, police cars, theaters, sports arenas, public buildings, business offices, and on commercial airplanes.

The American College of Emergency Physicians (2015) recommends the following steps for administering CPR to adults. The steps are organized into the “ABCs of CPR”—*airway*, *breathing*, and *circulation*—to help people remember the order in which to administer the steps.

Airway

Step 1: Check for responsiveness. Shake or tap the person gently. See if the person moves or makes a noise. Shout, “Are you OK?” No response: Call 911. Shout for help and send someone to call 911. If you are alone, call 911 and retrieve an AED (if available), even if you have to leave the person.

Step 2: Carefully place the person on his or her back. If there is a chance the person has a spinal injury, two people should move the person to prevent the head and neck from twisting. Once the airway is open, check to see if the person is breathing.

Breathing

Step 3: Place the person carefully on his or her back. Tilt the head back and lift the chin until the teeth almost touch. Look for signs of breathing.

Step 4: If the person is not breathing, pinch the nose and give the person two full breaths about 2 seconds long to produce a visible chest rise.

Circulation (Chest Compressions)

After giving two full breaths, immediately begin chest compressions (and cycles of compressions and rescue breaths). Do not take the time to locate the person's pulse to check for signs of blood circulation.

Step 5: Kneel at the person's side near the chest. Place your hands in the center of the person's chest between the nipples. Place one hand on top of the other; with elbows locked, press the heel of your hand into the chest.

Step 6: Give 30 hard, rapid compressions (about 100 per minute) for every two full breaths; repeat until medical help arrives or until the person starts breathing.

Immediate administration of CPR can double the chance of a person surviving sudden cardiac arrest. For instructional videos, see

the following:

Australia Health Service, https://www.youtube.com/watch?v=RMd7OB_WTeU;



Infected Gums Contribute to Heart Disease

We all know that cleaning your teeth and gums prevents dental caries. Here is another strong reason for oral cleanliness. Some research has shown an association between infected gums and risk of heart disease. Bacteria found in the mouth have also been detected in the plaques that block arteries.

About one-half of all Americans older than age 30 have gingivitis, a mild inflammation of the gums caused by oral bacteria; about one-third older than 30 have periodontitis, acute gum inflammation, and gum disease. (Smoking is a primary cause of this condition.) If your gums bleed when you brush or floss, see your dentist for treatment for gum disease. Maintaining oral health when you are young may also prevent heart disease later in life.

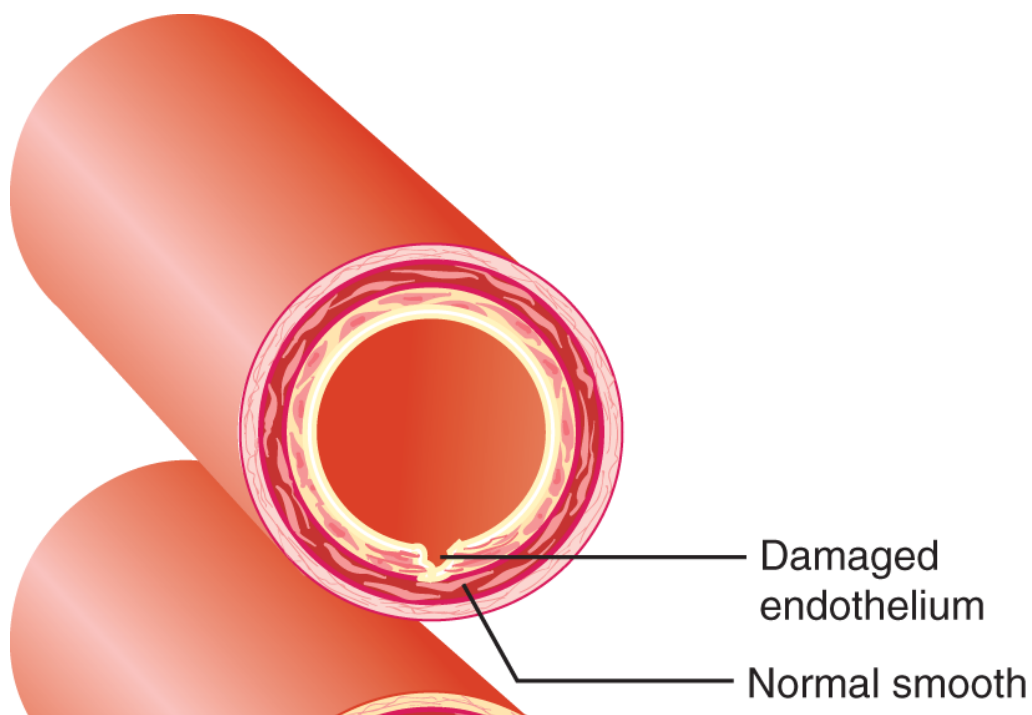
Cincinnati Children's Hospital Adult CPR,
<https://www.cincinnatichildrens.org/health/c/adult-cpr>; and

Hands-only CPR (King County, WA),
<https://kingcounty.gov/depts/health/emergency-medical-services/community/cpr-education.aspx>

By performing hands-only CPR to the beat of the classic disco song "Stayin' Alive," you can double or even triple a victim's chance of survival. Learn the two easy steps to save a life at heart.org/handsonlycpr.

Atherosclerosis

Cardiovascular disease is the leading cause of death in the United States and many other countries. About 50% of those deaths are the result of **atherosclerosis**, a disease in which fibrous fatty deposits called *plaque* form in the walls of one or more arteries (**Figure 10.8**). Plaques enlarge over time and ultimately slow or completely block the flow of blood in an artery, thereby harming the health of the tissues that the artery feeds. Atherosclerosis is most critical when it occurs in one or more of the four **coronary arteries** that carry blood in the heart itself and any artery that distributes blood in any part of the brain. Depriving heart tissue of blood can lead to death of the affected heart muscle, resulting in a heart attack. Depriving brain tissue of blood can lead to loss of neurological function (e.g., paralysis) or death from a stroke. Atherosclerosis is type of **arteriosclerosis** (“artery narrowing”), which refers to a thickening and stiffening of an artery’s wall that results in a retardation of blood flow.



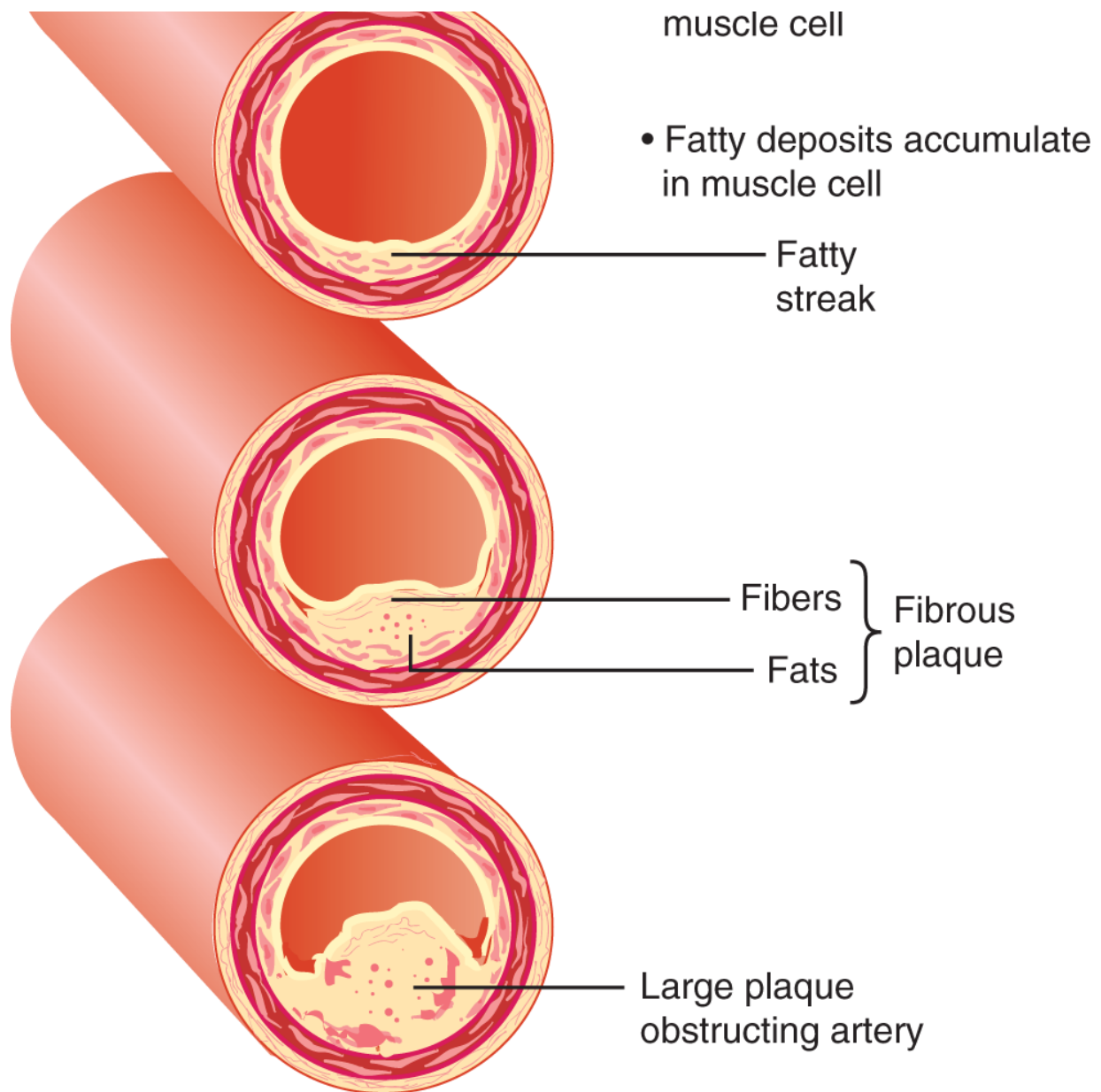


Figure 10.8 Development of an Atherosclerotic Lesion (Plaque) Inside an Artery.

Plaque can eventually block blood flow, causing a heart attack or stroke. Many factors are involved in the formation of a plaque, including cholesterol and lipid levels, immune system cells, and inflammation.

Description

The development of atherosclerotic plaques in an artery is the result of three interconnected processes: (1) prior damage to an artery's wall from nicks and tears due to the force of blood flowing

through it or from prior disease; (2) the deposition of excess cholesterol into the arterial wall, usually at the site of prior damage; and (3) inflammation, the process by which the immune system copes with the damage in the artery wall and the deposition of excess cholesterol.

Cholesterol is a waxy substance that has several vital functions in the body, including being a necessary structural component of cell membranes, a building block of several different hormones, and a precursor of bile salts. In one way or another, the body's cholesterol comes from food; about 20% from what is consumed in meals and about 80% that is manufactured primarily in the liver from dietary carbohydrates and fats. That the formation of atherosclerotic plaque involves the deposition of excess cholesterol in arteries is the reason that healthy diet recommendations include limiting foods high in cholesterol, saturated fat, trans fat, and sugar.

The liver determines the manufacture of much of the body's cholesterol and its distribution through the blood to tissues and organs when they need it. To facilitate the distribution process, cholesterol and another fat manufactured from dietary carbohydrate and fat, called *triglyceride* (TG), are packaged into small spherical particles called **lipoproteins**, which are able to transport them in the blood. Two types of lipoprotein particles are fundamentally involved in the development of atherosclerosis: **high-density lipoproteins (HDLs)** and **low-density lipoproteins (LDLs)**. They have different functions that, in some sense, are opposite to one another. Other kinds of cholesterol-carrying particles also are found in the blood, but these are ultimately converted into LDL particles.

LDL Particles

The cholesterol that becomes deposited in plaques that block arteries comes mainly from LDL particles, which circulate in the blood to deliver cholesterol to tissues to build new cells or as building blocks for other biological chemicals. Any excess cholesterol is processed by the liver to maintain normal cholesterol levels in the blood. LDL receptors on the surface of liver cells bind LDL particles and remove them and the unused cholesterol from the blood. If the

liver is overwhelmed with LDL particles, however, it may not be able to process all of them. When that occurs, those LDL particles and their associated cholesterol circulate in the blood and may be deposited in the walls of arteries.

Furthermore, some LDL particles can get trapped in an arterial wall, at which point they can become chemically modified through a process called *oxidation*, and they also contribute to the formation of plaque. As the plaque grows in size, it can dislodge from the artery and block blood flow. Or the plaque can break apart and cause a blood clot to form, which also can block the flow of blood in the artery. This is the reason LDL is called *bad cholesterol*. This is one reason that LDL-lowering medications are employed to lower the risk of atherosclerosis.

HDL Particles

HDL particles are produced in the liver and intestines and are released into the bloodstream. As HDL particles circulate through the body, they pick up cholesterol and return it to the liver for removal. Thus, HDL particles in cells and arteries scavenge excess cholesterol from the blood and arteries, thereby reducing the buildup of plaques. This is the reason HDL is called *good cholesterol*.

An example of the body's inability to process cholesterol are persons with an inherited disease called **familial hyperlipidemia (FH)**, which results in markedly elevated levels of cholesterol in the blood. People with this disease have two malfunctioning genes, one inherited from each unaffected parent. The normal forms of these genes are responsible for manufacturing LDL receptor proteins on liver cells that bind LDL particles and remove cholesterol from the blood. As a result of their malfunctioning genes, people with FH cannot manufacture these LDL receptor proteins. Thus, cholesterol cannot be removed from the body, and it accumulates to high levels in the blood. This leads to the formation of plaque that blocks arteries. People with this disease are at high risk for heart attacks.

Measuring Cholesterol Levels

One way doctors assess a person's risk for heart and blood vessel disease from atherosclerosis is to measure levels in the blood of total cholesterol, LDL cholesterol, HDL cholesterol, and triglyceride from a standard blood test. These measurements are reported as milligrams per deciliter (1/10th of a liter) of blood. The interpretations of the results of a cholesterol blood test are presented in the Wellness Guide box "How to Interpret Blood Cholesterol and Lipid Measurements." Often a physician will counsel someone with high blood cholesterol, high LDL-cholesterol, or low HDL cholesterol to adopt lifestyle habits to lessen the risk of heart disease posed by those results or suggest medication such as statins.

Statins are types of drugs that dramatically reduce the level of blood cholesterol. Statins are among the top-selling prescription drugs in the world. Statins act by inhibiting an enzyme—HMG-CoA reductase—in liver cells that manufactures cholesterol, so production of cholesterol by the body is markedly reduced. Another benefit of statins is that, by blocking the production of cholesterol, they force the liver to increase production of the receptors on liver cells that bind LDL cholesterol. This aids the removal of excess cholesterol from the circulation. People with high cholesterol levels (*hypercholesterolemia*) respond to treatment with statins by a marked reduction in their blood cholesterol levels. More than 40 million Americans age 18 and older now take a statin drug to reduce the risk of dying from a heart attack (Beil, 2017). Once you have been prescribed a statin drug to reduce your cholesterol and triglyceride blood levels, it is assumed that you will take that medicine for the remainder of your life. But the benefits and risks of taking a statin differ for each person, and many physicians are much more cautious about prescribing a statin, especially for a young adult.



Risk factors for cardiovascular disease include cigarette smoking, high blood pressure, high blood cholesterol, sedentary lifestyle, overweight, and excessive alcohol consumption.

© BananaStock/Getty Images Plus/Getty Images

Most people taking a statin drug experience relatively minor and manageable side effects, although significant side effects are possible. These include permanent liver or muscle damage, neurological impairment, memory loss, reduced cognitive functioning (fuzzy thinking and inability to concentrate on an idea or task).

Cholesterol levels tend to rise naturally with age, so many elderly people take statins and may have problems that are exacerbated by the drug.

According to the U.S. National Heart, Lung, and Blood Institute (2021a), several lifestyle habits and biological conditions constitute risk factors for developing atherosclerosis and its high risk of heart attack and stroke. Many of these risk factors can be modified by adopting healthy behaviors, and others can be modified by adhering to competent medical preventive treatment ([Table 10.3](#)).

TABLE 10.3 **Risk Factors for Atherosclerosis**

Risk Factor	Reason
High LDL cholesterol (“bad” cholesterol)	Increased plaque development and plaque inflammation
Low HDL cholesterol (“good” cholesterol)	Decreased plaque removal
High blood triglycerides (TGs)	Increased blood LDL cholesterol
High blood pressure	Damages blood vessels
Tobacco smoking	Damages and narrows blood vessels, raises cholesterol levels, raises blood pressure
Prediabetes, diabetes	Unable to regulate the body’s blood sugar level resulting in impaired fat metabolism
Overweight or obesity	Contributes to high levels of LDL (“bad cholesterol”) and triglycerides
Lack of physical activity	Lowers HDL and contributes to high LDL cholesterol, high triglycerides, high blood pressure, overweight, and diabetes

Risk Factor	Reason
Unhealthy diet	Foods that are high in saturated and trans fats, cholesterol, sodium (salt), and sugar can worsen other atherosclerosis risk factors
Older age	Over time, arteries undergo damage; plaque can increase over time
Genetics	Certain genetic diseases can cause high cholesterol or high TG
High C-reactive protein	Sign of inflammation in the body because of damage to blood vessels; creates a risk for plaque formation
Sleep apnea	A risk for high blood pressure
Stress	Increases bodily inflammation
Heavy drinking	Damages the heart muscle

Data from U.S. National Heart, Lung, and Blood Institute. (2021). Atherosclerosis. <https://www.nhlbi.nih.gov/health-topics/atherosclerosis>.



How to Interpret Blood Cholesterol and Lipid

Measurements

In evaluating your risk of heart and artery disease, the level of four different molecules are measured: cholesterol, high-density lipoproteins, triglycerides (lipids), and low-density lipoproteins. The range of values for each is indicated below.

Cholesterol

- Below 200 mg/dl: safe unless the HDL level is below 35 mg/dl.
- 200 to 239 mg/dl: borderline high. If you have other risk factors for heart disease such as high blood pressure or an HDL level below 35 mg/dl, then you are at risk and some corrective action is needed.
- Above 240 mg/dl: high. Further tests are needed. Dietary changes, as well as drugs to lower the level, may be recommended.

High-Density Lipoprotein

- 35 mg/dl: low. Exercise and other steps may be needed to raise the level. Women generally have higher levels of HDL than men.
- 35 to 60 mg/dl: considered protective, especially if cholesterol levels are below 240.

Triglycerides

- Below 200 mg/dl: considered normal range.
- 200 to 400 mg/dl: borderline high.
- Above 400 mg/dl: high. Dietary changes recommended.

Low-Density Lipoprotein

LDL is not measured directly, but levels are calculated according to the following formula:

$$\text{LDL} = \text{Total cholesterol} - \text{HDL} - (\text{Triglycerides}/5)$$

Using this formula, an LDL value below 130 is considered safe; a value above 160 is considered high, and lipid-lowering drugs may be prescribed. However, even this formula does not satisfy all the experts, some of whom believe that the ratio of LDL to HDL is the really significant measure of risk for heart disease.

Coronary Heart Disease and Heart Attack

Despite its relatively small size among the body's organs, the heart utilizes about 20% of the oxygenated blood circulated throughout the body. This is because the heart continually works every minute day and night and needs considerable energy and nutrients to do so.

Oxygen and nutrients are supplied to the heart through the four small coronary arteries that branch off the aorta, the body's main and largest artery. If one or more of the coronary arteries becomes blocked by plaque, heart muscle cells may not get enough oxygen and nutrients to function properly, and those cells may die. The death of a large number of cells can cause the heart to stop functioning—a heart attack. A mild to moderate heart attack may not be fatal, unlike a massive heart attack, which usually is.

If a heart attack has occurred, the levels of certain proteins in the blood such as creatine kinase, troponin, myoglobin, and myosin begin to change. Measuring the levels of these proteins allows physicians to determine quickly whether a heart attack has occurred and to initiate appropriate treatment.

If the coronary arteries become partially blocked and the heart cells do not get enough oxygen, chest pain called **angina pectoris** results. The drug nitroglycerin dilates blood vessels and is used to relieve the pain of angina. If a plaque ruptures and a coronary artery becomes completely blocked, then the person may have a fatal heart attack.

Each year in the United States about a million people are admitted to hospitals because of possible heart attacks. Tests eventually rule out a heart attack in about 50% of those admitted. Chest pains that mimic those of a heart attack can be brought on by severe indigestion (heartburn), panic, and stress.

Repairing Blocked Coronary Arteries

To determine whether coronary arteries are blocked by plaque or blood clots or to what extent, a precise image of the flow of blood through the coronary arteries that supply blood to the heart can be obtained by a procedure called **cardiac catheterization**. A thin tube is threaded from an artery in a leg or arm up into the heart's coronary arteries. A dye is injected, and high-speed X-ray film records the flow of the dye in the arteries to visualize any blockage. Several million cardiac catheterizations are performed each year in the United States on patients with suspected partial blockage of their coronary arteries.

When medical tests show that one or more coronary arteries are blocked, several medical procedures are available to remove the blockage. Two effective procedures are *coronary artery bypass graft* and *percutaneous transluminal coronary angioplasty*.

Coronary Artery Bypass Graft

coronary artery bypass graft (CABG) is open-heart surgery. The patient is fully anesthetized and the chest is surgically opened to expose the heart. Tubes are connected to the blood vessels leading to and from the heart so that blood can be diverted around the heart and through a mechanical pump. A part of a healthy artery or vein, often the saphenous vein in the lower leg, is removed from its normal site in the body and its ends are connected, or grafted, to the blocked coronary artery (**Figure 10.9**). When in place, the graft allows blood to flow around (bypass) the blocked portion of the coronary artery, creating a new path for oxygen-rich blood to flow to the heart muscle. Usually CABG is performed if three or all four of the coronary arteries are blocked (*triple* or *quadruple* bypass). About 280,000 CABG procedures are performed each year in the United States.

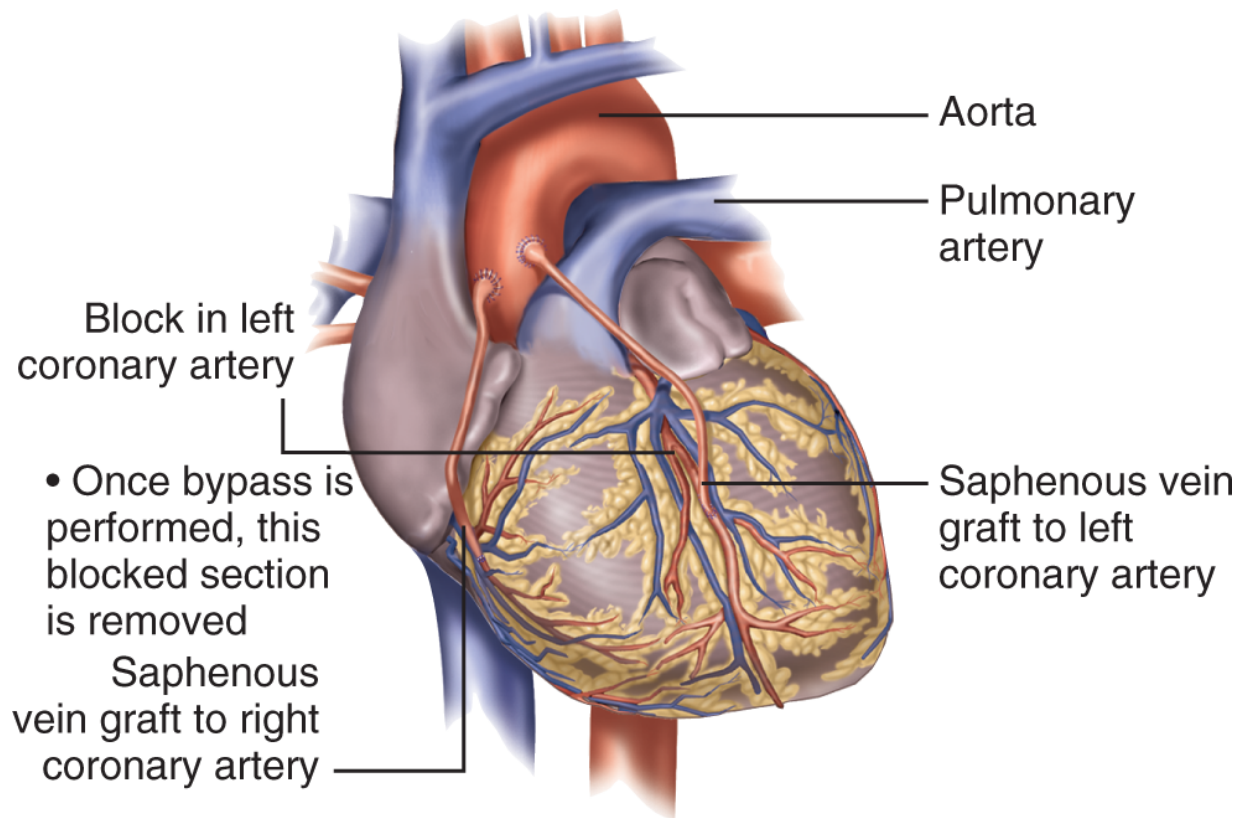


Figure 10.9 Diagram of the Coronary Arteries Showing Where Grafts Are Made to Correct Blockages.

Description



Concussion to the Heart

Most everyone knows that a brain concussion is a form of brain damage from a blow to the head that may cause unconsciousness, problems in mental functioning, and headaches for weeks, months, and even years. A blow to the left side of the chest caused by a punch, thrown baseball, hockey puck, or other object may cause a concussion to the heart that is medically known as *commotio cordis*. Such a blow, even a light blow, if delivered at a precise moment during the rhythmic beating of the heart, can induce instant fibrillation (irregular heartbeat) and sudden death. Cases of *commotio cordis* are rare, but sports medicine experts suspect that many more go unreported. Unfortunately, only about 15% of affected persons—most of whom are children—survive. Sports carrying the highest risk of sudden death from *commotio cordis* are baseball, softball, and hockey. Use of chest protectors and softer balls can reduce the risk of

commotio cordis in some sports, especially among children and young athletes. Also, never punch or poke anyone in the chest.

Although effective in restoring normal blood flow to the heart, coronary artery bypass surgery carries the risk of brain damage and cognitive loss. Stroke is the most serious complication, occurring in 1% to 6% of patients undergoing bypass surgery. Many patients also notice some loss of both short- and long-term memory.

Percutaneous Transluminal Coronary Angioplasty

In contrast to CABG, which is an open-heart surgical procedure, **percutaneous transluminal coronary angioplasty (PTCA)**, or simply *angioplasty*, is nonsurgical and much less invasive.

In this procedure, a thin wire is threaded from the femoral artery in the thigh up to the point of blockage in a coronary artery. Another thin tube containing a deflated balloon is then slipped over the wire and threaded up to the area of the arterial plaque. The balloon is inflated and pushes the plaque back against the wall of the artery, thereby opening it up. Angioplasty costs about half as much as a bypass operation, but the frequency with which the blockage recurs is higher, making a repeat procedure more likely.

An alternative to balloon angioplasty for clogged coronary arteries is a procedure called *stenting*. This procedure also involves inserting a catheter into a blood vessel in an arm or leg and threading it to the point of blockage in either a coronary artery or the carotid artery in the neck. If a blockage is found, an object called a *stent* is inserted that props the artery open.

Stenting has become widely used because it is simpler, cheaper, and safer than bypass surgery. However, there are still questions as to whether bypass surgery or stenting is better for long-term survival. The original stents inserted into arteries consisted of bare metal. In a large number of patients, the stents and arteries often became blocked again within months or years, and the procedure had to be repeated. Now, drug-eluting stents are used that slowly release a drug that helps prevent the artery from becoming blocked again.

Life-threatening blood clots can develop in some patients with drug-eluting stents implanted in one or more arteries. Some studies indicate that for partial arterial blockage, drugs alone are safer and more effective than surgical insertion of drug-eluting stents.

All procedures for opening blocked heart and carotid arteries have similar rates of success and long-term survival. The particular procedure that is recommended for an individual patient depends on many factors, including the number of arteries blocked, the age of the patient, other complicating diseases, and economic circumstances.

Until recently, it was medical dogma that atherosclerosis was a progressive and irreversible disease. However, clinical studies involving patients with partially blocked arteries have shown that the blockages can be improved through lifestyle changes and that this entrenched medical view is incorrect (Ornish et al., 1998). Patients who are motivated and who change their lifestyle can improve the health of their arteries and avoid surgery. However, most patients with blocked arteries still opt for the quick fix of surgery, even though, for many, it is only a temporary solution to their cardiovascular problems because arteries often become blocked again within a few years after surgery. Many physicians still feel obligated to perform bypass surgery or stenting for fear of being sued for not recommending the standard and accepted medical treatment. Thus, heart and artery surgeries probably will continue to be performed excessively in our society until views change.

Stroke

Stroke, sometimes referred to as a *brain attack*, is a form of cardiovascular disease that affects arteries supplying blood to the brain. If a brain artery becomes blocked or ruptures, brain cells die within minutes from lack of oxygen. Parts of the body whose functions depend on these damaged areas in the brain consequently are affected. Thus, a person who has a stroke can lose the ability to speak or to see, become paralyzed in an arm or leg, or lose the use of one whole side of the body. Strokes can result from injuries to the

head or from weak spots in the arteries called **aneurysms** that balloon out and rupture. Strokes also can result when the heartbeat is weak and the heart does not pump enough blood through the arteries to the brain. The effects of strokes vary greatly, ranging from mild or unnoticed symptoms to sudden death.

Two main classes of stroke are ischemic stroke and hemorrhagic stroke. *Ischemic stroke* results when one or more blood vessels in the brain become blocked due to a clot in an artery in the brain or in one leading to the brain. *Hemorrhagic stroke* results when a blood vessel in the brain ruptures, which also deprives brain cells of oxygen.

The warning signs of a stroke are any of the following conditions that occur suddenly. Immediate medical attention is needed if any of these symptoms of stroke occur:

- sudden weakness or numbness of the face, arm, or leg on one side of the body;
- sudden dimness or loss of vision, especially in one eye;
- loss of speech, difficulty understanding speech, or trouble talking;
- sudden severe headaches with no known cause; and
- unexplained unsteadiness, dizziness, or sudden falls, especially with one of the other symptoms.

Some patients at risk for strokes may benefit from a surgical procedure called **carotid endarterectomy** that removes fatty deposits by inserting a stent in a clogged artery in the neck. These arteries supply blood to the brain and, if they become blocked, may cause a stroke. Blocked neck arteries can be detected by listening to the blood flow with a stethoscope and can be confirmed by an ultrasound scan. The principal danger of the surgery is that it may precipitate a stroke—the very thing that it is designed to prevent.

The best way to prevent a stroke is to reduce the risk factors. There are five controllable risk factors for a stroke:

1. high blood pressure,
2. heart disease,
3. cigarette smoking,
4. transient ischemic attacks, and
5. high red blood cell count, which thickens the blood and facilitates formation of a clot.

These risk factors can, for the most part, be controlled by lifestyle changes or medications or both. Risk factors for a stroke that cannot be changed include (1) increasing age, (2) being male, (3) race, (4) diabetes mellitus, (5) prior stroke, and (6) heredity.

High Blood Pressure (Hypertension)

Approximately 50% of adult Americans have high blood pressure (**hypertension**); among African American men and women, the rate is about 57%. In the United States and all industrialized countries, the risk of high blood pressure increases with age. About 7% of people 30 years old have high blood pressure; this rises to 50% among people 50 years old. However, hypertension is not inevitable. People who are strict vegetarians and who have low-salt diets are hardly ever diagnosed with high blood pressure as they age.

Hypertension is a serious cardiovascular disease that is responsible for many deaths. It can damage the heart muscle such that the heart cannot function properly or at all (heart failure). It also can cause the heart muscle to thicken, making it difficult for the heart to fill with enough blood to supply the body's organs, especially during exercise. And it can cause atherosclerosis in the coronary arteries, resulting in diminished blood flow to the heart muscle. High blood pressure can damage blood vessels, causing bulges that may burst (aneurysms), and diseases of the kidneys, brain (stroke and cognitive decline), eyes, and legs (peripheral artery disease).

About a third of individuals with high blood pressure are unaware that their blood pressure is high. Consequently, they also are unaware that they are at risk for heart disease, kidney disease, and stroke. This is why hypertension is often called the “silent killer.” When the cause of high blood pressure cannot be determined medically, it is referred to as **essential (primary) hypertension**. Essential hypertension accounts for more than 90% of cases of high blood pressure. The remaining cases of high blood pressure are associated with a recognizable biological cause such as a kidney abnormality, congenital defect of the aorta, or adrenal gland tumor. This type of high blood pressure is called **secondary hypertension**. Generally, when the cause of secondary hypertension is determined and corrected, blood pressure returns to normal.

High blood pressure may be caused by psychosocial factors. For example, people with low income and poor education are at higher risk for high blood pressure. Being poor or jobless may generate stress and raise blood pressure. African and Hispanic Americans have a higher prevalence of high blood pressure than White Americans. The stress of social and economic discrimination may also increase the risk of high blood pressure and heart disease (Dolezsar, McGrath, Herzig, & Miller, 2010). Hypertension is a disease of modern societies; even today, remote tribes in New Guinea and in the forests of Brazil do not develop hypertension.

Blood pressure is a measure of the force with which the heart pushes blood through the circulatory system. Blood pressure is a critically important indicator of the health of the cardiovascular system, which is the reason doctors measure it often. A person's blood pressure is measured using an instrument that records how high in millimeters, abbreviated mm, the blood pressure can lift a column of liquid mercury, abbreviated Hg. Thus, blood pressure is measured and recorded in terms of millimeters of mercury, or mm Hg.

Each time the heart contracts, blood is pumped through the arteries and exerts pressure on the arterial walls. Two pressures are measured. The maximum pressure in the arteries occurs when the heart contracts (**systole**), pumping blood from the heart to the lungs

and body. Between contractions, the blood pressure falls (**diastole**) as blood flows from one chamber of the heart to another. The blood pressure is reported in a shorthand way with systolic on top of a line and diastolic below the line, or “systolic over diastolic”—for example, 120/80, which is verbally communicated as “120 over 80.”

Healthy blood pressure is 120/80 mm Hg (systole/diastole). People with a systolic pressure of 120 to 139 mm Hg and a diastolic pressure of 80 mm Hg or less have *elevated blood pressure*. Systolic pressure above 140 mm Hg or diastolic pressure over 90 mm Hg indicates high blood pressure.

High blood pressure can be lowered by making certain changes in lifestyle. Overweight is a major risk factor that can be changed; increasing physical exercise can also reduce hypertension. Moderating salt and alcohol consumption also is beneficial. And ensuring that you are obtaining an adequate amount of potassium (eat more bananas) can also reduce blood pressure.

Tiny receptors in the walls of the arteries respond to changes in blood pressure. If blood pressure rises, these receptors send nerve signals to relax the arteries and to slow the heartbeat, thus returning blood pressure to normal levels. However, these regulatory mechanisms can be overcome by signals from the brain. Arteries can be constricted and blood pressure raised by thoughts and emotions. Fear, tension, anger, and anxiety activate the sympathetic nervous system, which sends signals to the arteries, causing them to constrict. If one's life is overly stressful or full of anger and frustration, arteries may stay constricted and blood pressure remain elevated.



Self-Care: Hand on Heart Exercise

Purpose: To lessen the experience of anxiety by activating the parasympathetic nervous system and release of the brain hormone oxytocin, the “calm and connect” hormone of

safety and trust, which quells the adrenalin- and cortisol-driven fight–flight–freeze biological stress response.

Directions

1. Sit or lie in a quiet place with few or no distractions. If you wish, close your eyes.
2. Place your left or right hand on your heart. If you wish, cover that hand with your other hand.
3. Breathe normally and gently (about 7–10 times a minute) and focus your attention on your heart. If you wish, you can gently massage your heart region. As much as you are able to, bring forth the image or memory of the individual who unconditionally loves and accepts you, you totally trust, and with whom you feel safe. If you wish, on each breath repeat a word or phrase that helps brings forth that sensation of acceptance and trust—for example, say or think the word *ease* or *peace* or say the phrase “I am OK” or “I am safe.”
4. Repeat this exercise a few times each day for one minute each time. A few minutes prior to sleep can aid transitioning from active “busy mind” to “calm mind” for sleep.
5. Practice daily (!) to rewire nerve networks in the hippocampus, prefrontal cortex, amygdala, and brain stem to reduce anxiety and increase safety, calm, and social confidence.

Data from Linda Graham “The Power of Mindful Empathy to Health Toxic Shame” *Wise Brain Bulletin*, Vol 4.1, 2010.

https://media.rickhanson.net/wisebrainbulletin/WBB_4_1.pdf.

Although drugs are the most common means of controlling hypertension, mental relaxation techniques are also effective. Biofeedback can help lower blood pressure. Healthy lifestyle habits can help prevent high blood pressure and reduce it once it has begun. These habits include healthy eating, such as following the Dietary Approaches to Stop Hypertension (DASH) diet (see Chapter 5), decreasing salt intake, increasing potassium intake, eating foods that are heart healthy, being physically active, maintaining a healthy body weight, limiting alcohol consumption, and managing and coping with stress (see Chapters 3 and 4). To develop a health habit, make one healthy lifestyle change at a time and add another change when you feel that you have successfully adopted the earlier changes.

The Metabolic Syndrome

A model that pulls together many of the factors that are shared by people at risk for diabetes, cardiovascular disease, and heart attacks

is called the **metabolic syndrome**. A person with three or more of the following risk factors is defined as having metabolic syndrome:

- waist circumference greater than 40 inches for men and 35 inches for women,
- elevated triglyceride level of 150 mg/dl or greater,
- high-density lipoprotein (HDL) level of 40 mg/dl or lower for men and 50 mg/dl or lower for women,
- fasting blood glucose level of 100 mg/dl or higher (hyperglycemia), and
- high blood pressure (130/85 mm Hg or higher).

A national survey indicated that 6.7% of participants between ages 20 and 29 met the criteria for metabolic syndrome. The prevalence increased to 43.5% for participants aged 60 to 69 years. Because of the enormous number of people with metabolic syndrome in the United States who are at high risk of diabetes, cardiovascular disease, and premature death, metabolic syndrome is regarded as a pressing public health problem. Despite the fancy technical name, metabolic syndrome is really the result of poor lifestyles—smoking, overeating and becoming overweight, lack of exercise, and poor diet.

Lifestyle Factors and Cardiovascular Disease

About 37% of the 2.6 million American deaths each year are due to cardiovascular disease, principally coronary heart disease and stroke, both of which are manifestations of atherosclerosis. About 50% of those deaths are preventable by adopting healthy behaviors that not only enrich life but also reduce the risk of debilitation and suffering from a preventable chronic illness (Patel, Winkel, Ali, Narayan, & Mehta, 2015).

Researchers studied the effect of seven lifestyle factors on the risk of death from cardiovascular disease (Yang et al., 2012). The lifestyle factors were ones that had been previously identified as being heart healthy. They included not smoking tobacco, engaging in more than 150 minutes a week of movement activity, not being overweight, consuming a healthy diet, having healthy levels of total blood cholesterol, and maintaining normal blood pressure and blood sugar levels. Analysis of the research determined that only 25% of the people in the study population exhibited five or more healthy lifestyle factors; 8% exhibited none or only one. The study also found that those who lived most healthfully had less cardiovascular disease and lived the longest (**Figure 10.10**).

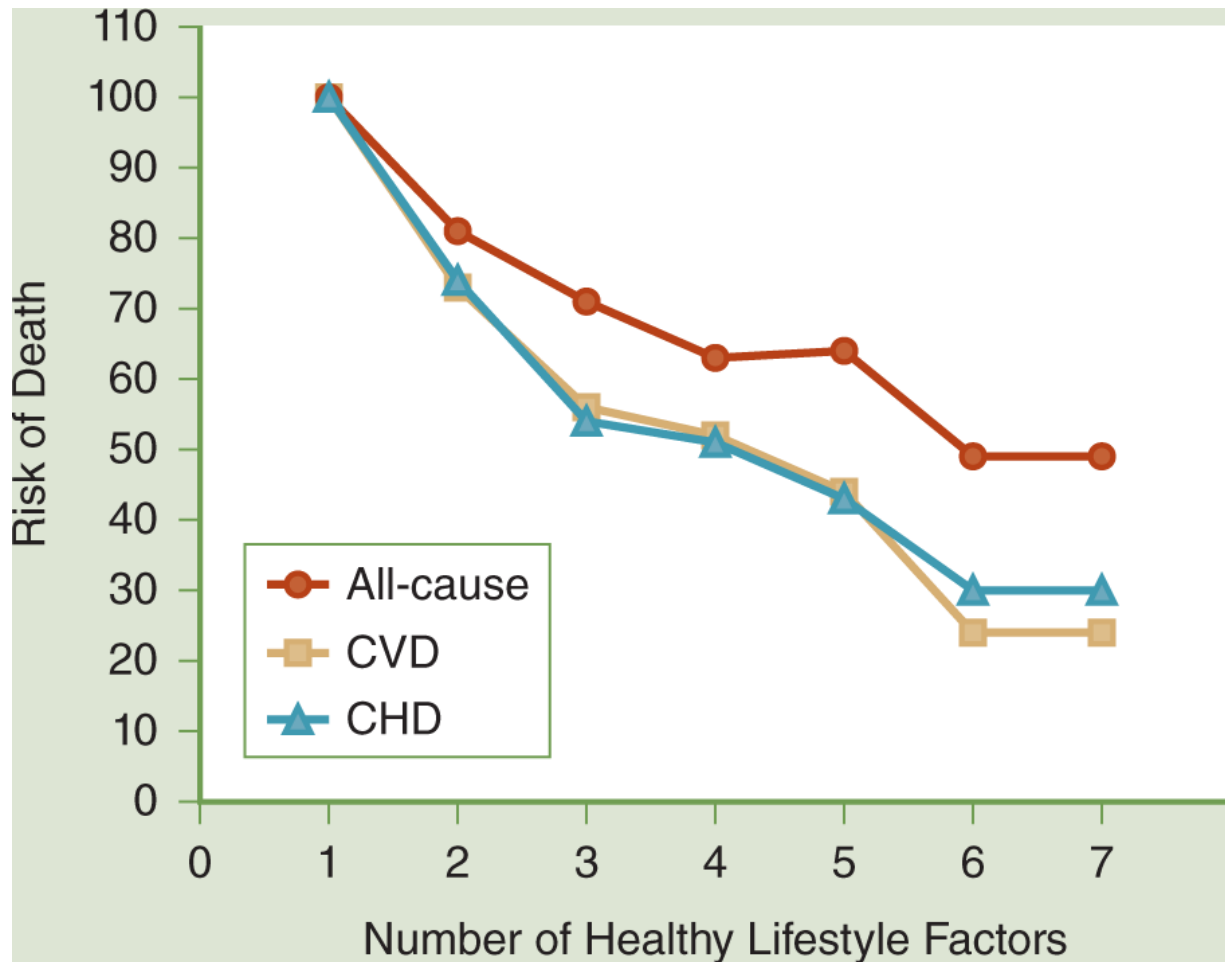


Figure 10.10 Association of Maintaining Healthy Lifestyle Factors on the Risk of Cardiovascular Disease. Living healthfully lessens the risk of death from all cardiovascular disease, coronary heart disease, and all causes. The healthy lifestyle factors include not smoking tobacco, more than 150 minutes a week of movement activity, not being overweight, consuming a healthy diet, healthy levels of total blood cholesterol, normal blood pressure, and a normal blood sugar level.

Description

No Tobacco Smoking

Principally through the process of oxidation and the inflammation that follows, the chemicals in tobacco smoke can damage blood cells, blood vessels, and the heart itself. Damage to cardiovascular tissue increases the risk of atherosclerosis, a major contributor to coronary heart disease, chest pain, heart attack, arrhythmias, heart

failure, and even death. Smoking is also a major risk factor for peripheral artery disease and subsequent risk of stroke and clogging of blood vessels in other organs and the limbs.

Stopping smoking at any time can reverse many of the harmful physiological effects of tobacco on the cardiovascular system. After several years of not smoking, ex-smokers have about the same risk of cardiovascular disease as nonsmokers. One key to protecting your heart is not smoking and not living or working in a smoke-filled environment.

Regular, Moderate Physical Activity

Moving the body regularly—even for just a few minutes a day—makes people feel better, gives them more energy, reduces anxiety and depression, and lessens cravings for alcohol, cigarettes, and junk food.

Moreover, 150 minutes per week of movement activity, be it recreational exercise, work-related movement, housework, or active transportation (walking, biking), can significantly reduce the risk of cardiovascular disease and death from heart attack, stroke, heart failure, and all-cause mortality (Lear et al., 2017).



Cardiovascular Fitness: Exercise Your Heart

The heart is a large bundle of muscle fibers that coordinate to act as a singular, powerful, highly efficient pump. With every contraction and relaxation cycle, the heart pumps oxygen-laden blood to every organ in the body. You never have to think about it. The heart does its job automatically, day after day, year after year, until life ends.

We hear a lot about the need for physical activity but not much about exercising the heart itself. Of course, when you engage in vigorous physical exercise (“breathe hard and sweat”) you also exercise your heart muscle because your heart rate increases and the heart muscle works harder to provide oxygen to exercising body muscles. However, it’s possible to be physically active without working the heart too much. This is especially true for people who are busy with work, family, and other obligations, and for whom time for recreational exercise all but disappears.

It is well documented that cardiovascular fitness is essential to reducing the risk of cardiovascular disease. To attain cardiovascular fitness, one should exercise several times a week to the point of increasing the heart rate close to the maximum for one's age. This can be accomplished by biking, jogging (road or treadmill), or walking vigorously. It may also be helpful to create an image visualization for exercise:

See the blood leave your heart and flow rapidly through your arteries and veins. The blood is moving so forcefully and fast that it scours the linings of the blood vessels, cleansing them of any debris and deposits that might clog them.

Think of it as “power washing” the cardiovascular system, especially the heart muscle and coronary and pulmonary arteries. Go! Then slow down for a bit to let your heart rate return to normal and then go again to increase your heart rate.

Regular physical activity strengthens the heart's ability to pump blood to the lungs and throughout the body and helps maintain healthy blood pressure, normal blood sugar and fat levels, increase blood levels of HDL cholesterol (good cholesterol), reduce inflammation, and help reduce overweight and tobacco smoking, two lifestyle factors associated with higher CVD risk.

Healthy Diet

Diets high in processed foods, natural sugar and high-fructose corn sugar, and meats containing considerable saturated fat can have a major impact on several risk factors for cardiovascular disease, including elevated LDL cholesterol, low HDL cholesterol, high blood levels of total cholesterol and triglycerides, high blood pressure, overweight, and type 2 diabetes (Rakel, 2017). Diets that lessen the risk of CVD such as the DASH and Mediterranean diets emphasize daily consumption of four to five cups of fruits and vegetables and three to six servings of whole-grain foods and low intake of saturated and trans fats, cholesterol, sugar, and salt (American Heart Association, 2017). However, other dietary factors may offer additional benefits.

Consuming Fish Oils

Populations that consume large amounts of fish in their diets—Greenland Inuit and Japanese islanders—have lower rates of CHD

than others. Americans who consume fish regularly in their diets also have healthier hearts. The protective effects of dietary fish have been ascribed to fish oils, in particular those containing omega-3 polyunsaturated fatty acids (omega-3 PUFAs). In some studies, supplements of fish oil have reduced levels of cholesterol and blood pressure. A summary of research on the role of omega-3 polyunsaturated oils in treatment and prevention of CVD concluded that they are most beneficial in people who are at high risk for CVD and have already experienced a heart attack or heart failure with reduced left ventricular function (Siscovick et al., 2017).

The beneficial effect of dietary fish on CVD is illustrated by observations of Bantu villagers in Tanzania. One group of Bantu lived on the shores of a lake, and people consumed about a pound of fish a day. The other Bantu population lived in nearby hills and had a diet that consisted primarily of vegetables. The Bantu people who ate fish had high levels of omega-3-polyunsaturated oils in their blood. They also had lower levels of cholesterol and lipoproteins (Pauletto et al., 1996). Sardines, salmon, and mackerel have high levels of omega-3-polyunsaturated oils, but all fish have some.

Low Salt (Sodium) Consumption

For decades, people have been urged to reduce their consumption of salt from an average of 10 grams per person per day to 6 grams per day or less. Many people find it difficult to reduce their salt intake because 80% of the salt consumed comes from processed foods and not from cooking or the salt shaker on the table. Because the taste of foods is enhanced by salt, food manufacturers are reluctant to reduce the amount of salt in their products. The major reason for recommending reducing salt intake to 3 grams per day is the possible increased risk of high blood pressure from consuming too much salt (U.S. Centers for Disease Control and Prevention, 2021b). In people with normal blood pressure, reducing salt intake has no effect on blood pressure. However, in people with high blood pressure or whose bodies have a high sensitivity to salt, consuming less salt is associated with a drop in blood pressure.

Eliminating most processed foods from your diet will automatically reduce your daily salt intake by the currently recommended 3 grams per day. And substituting fresh foods for processed foods is one of the healthiest things you can do for yourself overall.

Aspirin

Low-dose aspirin (81 milligrams, a “baby aspirin”) is often recommended to reduce the risk of CHD and heart attacks in people who have had a heart attack or stroke, with the intention of preventing another occurrence of a life-threatening cardiovascular event. Aspirin lessens the risk of blood clots and also combats inflammation. Medical research regarding use of aspirin to prevent a first heart attack or stroke is mixed. In general, aspirin may be recommended only to people who have known risk factors for heart attack. The anti–blood-clotting action of aspirin is dangerous, and people with low risk of heart disease should not expose themselves to that risk.

Alcohol

Many studies have confirmed that light to moderate alcohol consumption (up to one drink per day for women and up to two drinks per day for men) is associated with a lower risk of cardiovascular disease (Bell et al., 2017). Much of the decreased risk results from a reduction in LDL cholesterol and an increase in HDL cholesterol, and hence a lessening of risk of death from coronary heart disease.

At moderate intake, alcohol reduces LDL cholesterol, increases HDL cholesterol, and reduces inflammation. However, at higher levels of regular consumption, alcohol is associated with high blood pressure and a weakened heart muscle. That moderate alcohol consumption is associated with a lower risk of cardiovascular disease should not be taken to mean that alcohol consumption—particularly heavy or binge alcohol consumption—is healthy. Alcohol consumption still presents many noncardiovascular health risks.

Although moderate alcohol may protect from a heart attack, many dietary and lifestyle changes are much more beneficial to your heart than drinking alcohol. On the other hand, persons who enjoy a drink occasionally need not feel guilty that they are damaging their health.

Psychosocial Factors

Psychosocial factors are associated with both the development and progression of cardiovascular disease (Smith & Blumenthal, 2011). For example, many people cope with stress by smoking or overeating (especially high-fat and high-sugar “comfort foods”), two potent risk factors for cardiovascular disease. Other psychological factors that may increase the risk for cardiovascular disease include unpleasant emotional states such as depression, anxiety, anger, and distress; personality factors, such as hostility (Chida & Steptoe, 2009; Tindle et al., 2009); stressful social factors, including perceived racial discrimination (Dolezsar et al., 2010); and low socioeconomic status and low social support (Steptoe & Kivimaki, 2012). The biological relationships between psychosocial factors and cardiovascular disease include chronic changes in the stress-hormone system (hypothalamo–pituitary–adrenal axis) and inflammation.

Both immediate and long-term stressors are related to the risk of cardiovascular disease. Immediate mental stress such as catastrophic events (war, earthquakes) and intense sporting events (World Cup soccer) increase the risk for arrhythmias, decrease the flow of blood to the heart, and can cause a heart attack. Following the collapse of the World Trade Center on September 11, 2001, the number of cases of arrhythmia doubled compared to the weeks preceding the attack at the same time the prior year. This relationship is likely related to a sudden upsurge in excitatory nerve activity and secretion of adrenalin. Long-term stressors may be associated with cardiovascular disease through prior CVD, such as high blood pressure. Chronic stressors include work-related stress, marital dissatisfaction, financial stress, and stressful major life events (Rosengren et al., 2004).



It's important to encourage children to eat heart-healthy snacks so they won't have to break bad eating habits later in life.

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Genes May or May Not Increase the Risk of Heart

Disease

In humans, inheriting any of about 50 genes is associated with an increased risk of heart disease and heart attack, and the more heart disease risk genes a person inherits, the greater the risk of developing heart disease. To what degree heart disease genes confer risk, however, is largely affected by the extent of a person's heart-healthy lifestyle. Specifically, lifestyle factors can reduce genetic risks of heart disease and heart attack by 50%.

A study by Khera and colleagues (2016) of more than 50,000 people identified each participant's number of heart disease risk genes and heart-healthy lifestyle factors, consisting of no current smoking, no obesity (body mass index less than 30), physical activity (at least once a week), and a heart-healthy diet. As might be expected, the more heart disease risk genes, the greater the risk for heart disease. However, no matter how

many heart disease genes a study participant had, the risk of heart disease was lessened by 50% by adhering to a heart-healthy lifestyle.

Unhealthy habits can erode a person's health over time. While young, it is vital to take charge of your health and choose a healthy lifestyle. Your life depends on it!

Preventing Cardiovascular Disease

With the increased attention given to risk factors that cause cardiovascular disease, people are now armed with knowledge that can reduce their chances of heart attacks and brain attacks. People should maintain normal weight and avoid consumption of foods containing large amounts of saturated fats, trans fats, and cholesterol. A diet rich in fresh fruits and vegetables helps protect your heart and arteries. Understanding the adverse consequences of cigarette smoking should encourage smokers to quit. Also, consuming green tea and a glass of wine with dinner might be helpful. However, nothing is better for the heart than a healthy diet and plenty of exercise.



It's Not Too Late to Have a Healthy Heart

In 1985, about 5,000 American young adults aged 18 to 30 were recruited to participate in the Coronary Artery Risk Development in Young Adults (CARDIA) study to explore the development and prevention of heart disease (Spring et al., 2010). For the next 20 years, researchers followed five lifestyle behaviors for each participant: (1) not being overweight or obese, (2) low alcohol intake, (3) healthy diet, (4) physically active, and (5) nonsmoker. The researchers also measured a variety of known heart disease risk factors and conducted two tests to identify any signs of developing heart disease. Over the 20-year study, the participants were not coached in any way to change their lifestyle; any changes during that time were by personal choice.

At the beginning of the CARDIA study, 8% of the participants had all five healthy lifestyle factors and 36% had three. By the end of the study 20 years later, 25% of the participants had increased their number of healthy lifestyle factors, 40% had decreased their number of healthy lifestyle factors, and 35% had the same number as when the study began. Each lifestyle factor that changed from unhealthy to healthy resulted in a 15% reduction in risk for heart disease. And each lifestyle factor that changed from healthy to unhealthy resulted in a 15% increased risk of heart disease. For example, heavier smoking or being overweight or both at the time the study began increased the risk of showing signs of heart disease 20 years later. Never smoking or quitting smoking and not being overweight were associated with reduced risk.

These results show that no matter what your current lifestyle, it is never too late to benefit from making healthy lifestyle changes to reverse or change the progression of cardiovascular disease.

Data from Spring, B., et al. (2010). Healthy Lifestyle Change and Subclinical Atherosclerosis in Young Adults: Coronary Artery Risk Development in Young Adults (CARDIA) Study. *Circulation*,
<http://circ.ahajournals.org/content/early/2010/04/28/CIRCULATIONAHA.113.005445>.

Critical Thinking About Health

1. African Americans as a group have higher blood pressure on average than White Americans. Various hypotheses have been advanced to explain the differences in blood pressure between the races, including genetic differences, social factors, economic factors, diet, and behavioral differences. Imagine that you are a consultant to a medical charity that has been asked by a group of scientists at a medical school for \$100,000 to fund a research project to explain the observed racial differences in blood pressure. The charity realizes that \$100,000 is not sufficient to fund a thorough examination of this issue, so it asks you to list what you consider the three most important factors for the scientists to examine and your reasoning for your choices. The charity also asks you to propose a study for research of the factor you deem most important.
2. For yourself or anyone whom you care about, use the Mayo Clinic online tool for assessing of the risk for heart disease: <https://www.mayoclinichealthsystem.org/locations/cannon-falls/services-and-treatments/cardiology/heart-disease-risk-calculator>. Among the risk factors that can be changed, discuss how you would reduce them to improve your cardiovascular health now and for the future.
3. People in Japan or southern European countries have one-half to one-third the risk of dying from heart disease in comparison with people from the United States or northern Europe, even when their cholesterol levels, on average, are the same. A person with a cholesterol level of 250 mg/dl in Denmark has a two to three times greater risk of a fatal heart attack compared with an Italian with the same cholesterol level. Develop arguments to explain this difference that seem reasonable to you and organize your facts and ideas in the form of a hypothesis.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

The heart is the hardest-working muscle in the human body. Day after day, year after year, the heart beats about 60 to 80 times a minute to pump blood continuously to every organ and cell in the body and supply the nutrients and oxygen that keep us alive. The heart pumps freshly oxygenated blood through arteries to all parts of the body; veins return oxygen-depleted blood to the lungs. The veins also carry carbon dioxide, a by-product of chemical reactions in cells, back to the lungs where it is expelled with each exhalation.

We almost never think about our heart until it fails to function properly. In a healthy person, the heart can function flawlessly for more than 100 years, but heart disease and heart attacks are still the leading cause of death in the United States and many countries throughout the world. Many lifestyle and environmental factors can diminish or destroy the functions of the heart and circulatory system. Among the factors most destructive to the circulatory system are tobacco smoke, high levels of cholesterol and lipids, high blood pressure, and obesity. High levels of stress over prolonged periods also are unhealthy.

You can help ensure a healthy heart and circulatory system by maintaining proper weight, exercising on a regular basis, and eating a variety of fresh foods, particularly fruits and vegetables. Avoid processed foods as much as possible, especially ones high in fat, sugar, and salt. The time to protect your heart is when you are still young and healthy. Think about how you would care for a treasured possession that you want to last for 100 years. If you have a choice of where to live, pick a place where the air you breathe and the water you drink are still relatively unpolluted. Toxic environments are not conducive to a healthy lifestyle or to the long-term health of your heart.

HIGHLIGHTS

- The heart is a pump that maintains blood circulation in the arteries and veins. The arteries carry oxygen and nutrients to cells, and the veins carry carbon dioxide back to the lungs.
- Damage to the heart or arteries is called *cardiovascular disease*; it is the leading cause of death in the United States.
- Major risk factors of heart disease that cannot be changed are heredity, gender, and age.
- Major risk factors for cardiovascular disease that can be changed are tobacco use, high blood cholesterol, high blood pressure, physical inactivity, and poor diet.
- Other factors that contribute to heart disease are diabetes, obesity, and stress.
- Various surgeries are performed to repair clogged arteries: coronary artery bypass surgery, angioplasty (stenting), and endarterectomy.
- One baby aspirin (81 mg) each day may reduce the possibility of a heart attack for someone at risk.
- Soy products, fish oils, cocoa, and green tea can keep the heart healthy.
- Heart disease is caused by modern lifestyles and can be prevented. Making changes in your diet, not smoking, and increasing exercise while you are young can help keep the heart, arteries, and brain healthy throughout life.

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KEY TERMS

cardiovascular disease (CVD):

any disease that causes damage to the heart or the body's blood vessels

rheumatic heart disease:

damage to heart valves from bacterial infection

coronary heart disease (CHD):

disease caused by fatty deposits in the heart's coronary arteries that impede or completely block the transport of oxygen and nutrients to the heart muscle cells

plaque:

deposit of fatty substances in the inner lining of arteries

heart attack:

death of, or damage to, part of the heart muscle caused by an insufficient blood supply

blood pressure:

measurement of the force with which the heart pushes blood through the circulatory system

arteries:

any of a series of blood vessels that carry blood from the heart to all parts of the body

veins:

blood vessels that return blood from tissues to the heart

capillaries:

extremely small blood vessels that carry oxygenated blood to tissues

myocardium:

muscular wall of the heart that contracts and relaxes

aorta:

the large artery that transports blood from the heart to the body

heart failure:

when the heart is weakened to the degree it cannot pump blood throughout the body

sinoatrial node:

the region of the heart that produces an electrical signal that causes the heart to contract

atrial fibrillation (“a-fib”):

rapid, erratic contraction of the upper chambers of the heart

pacemaker:

an electrical device implanted in the chest to control irregular heartbeats

ventricular fibrillation (“v-fib”):

irregular quivering of the lower chambers of the heart

defibrillator:

an electrical device that can restart a heart that has stopped beating by delivering electrical shocks to it

open-heart surgery:

surgery performed on the opened heart while the blood supply is diverted through a heart–lung machine

cardiologist:

a physician who specializes in diseases of the heart

varicose veins:

swelling of veins (usually in the legs) resulting from defective valves

cardiopulmonary resuscitation (CPR):

an emergency lifesaving procedure used to revive someone who has stopped breathing or suffered cardiac arrest

atherosclerosis:

a disease process in which fatty deposits (plaques) build up in the arteries and block the flow of blood

coronary arteries:

two arteries arising from the aorta that supply blood vessels to the heart muscle

arteriosclerosis:

hardening of the arteries

lipoproteins:

spherical particles that transport cholesterol and fat (TG) in the blood

high-density lipoprotein (HDL):

the carrier of cholesterol from tissues to the liver for removal from the circulation; carrier of “good” cholesterol

low-density lipoprotein (LDL):

the carrier of “bad” cholesterol in blood

familial hyperlipidemia (FH):

an inherited disease causing extremely high levels of cholesterol in the blood

statins:

a class of drugs that block synthesis of cholesterol in the liver and reduce the amount of cholesterol in the blood

angina pectoris:

medical term for chest pain caused by coronary heart disease; a condition in which the heart muscle doesn't receive enough blood, resulting in chest pain

cardiac catheterization:

visualization of blocked coronary arteries by using a catheter and monitoring blood flow in coronary arteries; a dye is injected through the catheter

coronary artery bypass graft (CABG):

surgery to improve blood supply to the heart muscle by replacing the damaged portion of the blocked artery with a graft

percutaneous transluminal coronary angioplasty (PTCA):

a procedure to open blocked arteries

stroke:

death of brain cells due to an insufficient supply of blood to the brain, resulting in loss of muscle function, loss of speech, or other symptoms; also called a *brain attack*

aneurysms:

ballooning out of a vein or artery

carotid endarterectomy:

removal of fatty deposits in arteries in the neck to prevent a stroke

hypertension:

high blood pressure

essential (primary) hypertension:

high blood pressure that is not caused by any observable disease

secondary hypertension:

high blood pressure caused by a recognizable disease

systole:

the pressure in the arteries when the heart contracts (the higher number)

diastole:

the pressure in the arteries when the heart relaxes (the lower number)

metabolic syndrome:

a model embracing five risk factors that puts people who have at least three risk factors at risk for cardiovascular disease, diabetes, and premature death

electrocardiogram (EKG):

a test that shows the rate and rhythm of the heartbeat



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CHAPTER 11

Cancer: Understanding Risks and Means of Prevention



Health Tips

Signs of Melanoma

Abortion Does *Not* Increase Risk of Breast Cancer

Don't Be Fooled by "Miraculous" Cancer Cures



Managing Stress

Visualization Helps Healing



Wellness Guide

Self-Care Practice: Gratitude

What Do Indoor Tanning Lamps and Cigarettes Have in Common?

LEARNING OBJECTIVES

1. Identify at least three major ways to prevent cancer.
2. Identify the most prevalent types of cancer.
3. Define the following terms: cancer, tumor, benign tumor, malignant tumor, metastasis.
4. Explain the difference between inherited and genetic diseases as they pertain to cancer.
5. Describe the kinds of environmental agents that cause cancer.
6. Explain ways to prevent skin cancer.
7. Discuss some risk factors associated with breast cancer.
8. Discuss how cigarette smoke contributes to cancer.
9. Discuss the association between diet and cancer.
10. Describe the three medical treatments for cancer.
11. Describe several coping mechanisms for someone with cancer.
12. Explain the risks and benefits of being tested for a cancer susceptibility gene.

Cancer is a scary word. Almost everyone knows, or knows about someone, who got extremely sick or who died from cancer, sometimes with pain and suffering. Surveys show that many people think of cancer as a malicious, vicious, unpredictable, and

indestructible enemy, lurking inside a person's body and stealthily spreading. By the time it is discovered, it is too late.

The term *cancer* comes from the Latin word meaning “crab.” Cancer was characterized by the ancient Greek physician Hippocrates, the father of modern medicine, as a crablike disease that spread throughout the body, eventually cutting off life. Many people fear cancer more than a natural disaster or an actual enemy attack. “Conquering cancer” is among the highest of national health goals (Vrinten et al., 2017).

Currently, about 1.9 million new cases of cancer are diagnosed in the United States each year, and about 600,000 people die from the disease, making cancer the second leading cause of death. Worldwide, about 18 million new cases of cancer occur each year and about 10 million people die of cancer-related deaths. Approximately 40% of men and women will be diagnosed with cancer at some point during their lifetimes. Despite the terrifying imagery and dismal statistics, cancer is neither inevitable nor insurmountable. Many cancers are avoidable by adopting the recommended lifestyle practices for living a healthy life: no tobacco smoking; maintain a healthy body weight; engage in moderate levels of physical activity, manage stress, stay socially connected; and consume a healthy diet based on fresh fruit, vegetables, whole grains and limited amounts of red and processed meats and alcohol. Cancer-specific health behaviors include avoiding excess exposure to ultraviolet radiation in sunlight and from tanning booths, limiting exposure to cancer-causing agricultural and industrial chemicals, and being vaccinated against hepatitis B virus (HBV) and human papilloma virus (HPV). If everything known about lessening the risk of cancer were practiced by everyone, about 60% of all cancers could be prevented.

In nature there's no blemish but the mind. None can be called deformed but the unkind.

—William Shakespeare, *Twelfth Night*

Furthermore, half of all cancer patients can be cured if their cancer is detected at an early stage before cancer cells have spread. Being “cured” of cancer means that a person’s life expectancy is the same as for a person who never had cancer. It is important to have cancer screening tests as indicated for your age and risk group (**Table 11.1**). You should also watch for early warning signs in functions of the body that may indicate that a cancer is developing.

TABLE 11.1 | Recommended Screening Tests for Cancer Detection and Prevention

Test	Sex	Age	Frequency of Testing
Colonoscopy	M & F	50 and over	Every 10 years
Flexible sigmoidoscopy	M & F	50 and over	Every 5 years
Double-contrast barium enema	M & F	50 and over	Every 5 years
Fecal occult blood test	M & F	50 and over	Every year
Fecal immunochemical test (FIT)	M & F	50 and over	Every year
FIT-DNA test	M & F	50 and over	Every year
Digital (finger) rectal examination	M	50 and over	Every year
Prostate-specific antigen	M	50 and over	Every year
Pap test	F	18 and over	Women should begin getting a Pap test with the start of sexual activity, but no later than at 21 years of age, and repeat the test at least every 3 years
Breast self-examination	F	20 and over	Every month
Breast clinical examination	F	20–40 40 and over	Every 3 years Every year
Mammography	F	40 and over	Every 1–2 years

Note: The Centers for Disease Control and Prevention reports that clinical and breast self-exams have not been shown to reduce the incidence of breast cancer death and that women should rely on mammogram for adequate screening.

U.S. Centers for Disease Control and Prevention (2021). <https://www.cdc.gov/cancer/dccp/prevention/screening.htm>

Description

Understanding Cancer

Incidence of Various Cancers

The annual number of new cases of cancer at various body sites is shown in **Figure 11.1**. Although the incidence of some cancers has decreased somewhat since 2000, the incidence of other cancers, such as non-Hodgkin lymphoma and melanoma, has increased. Thus, overall, cancer rates have not changed much since the 1980s, despite the introduction of sophisticated medical screening and treatment methods. That the incidence of cancer has not changed suggests that medical science and society at large must turn more attention to prevention if cancer rates are to decline significantly.

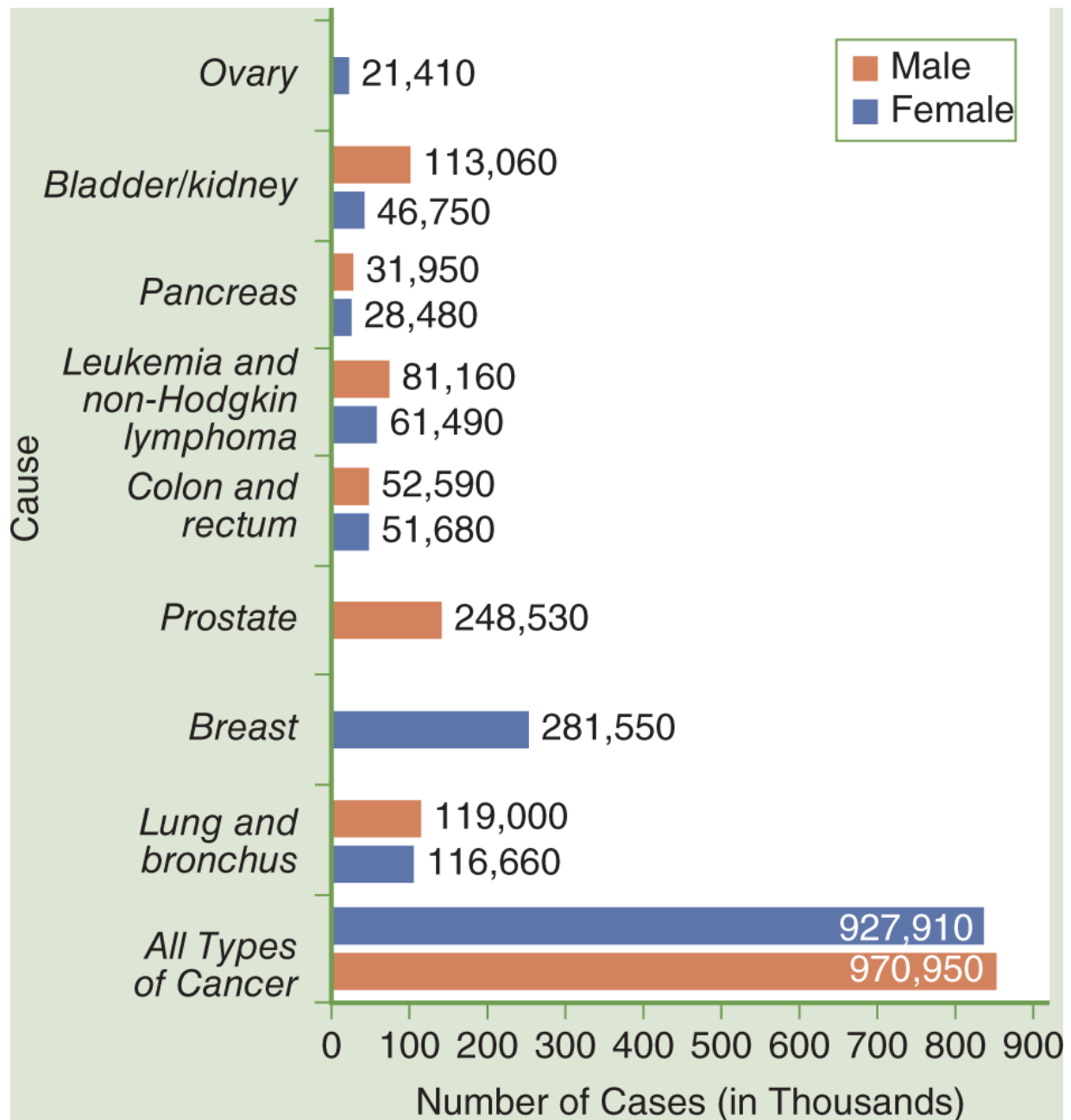


Figure 11.1 Estimated Number of New Cancer Cases, United States, 2021.

Data from American Cancer Society. (2021). *Cancer facts and figures*, 2021. Retrieved from <http://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2021.html>.

Description

What Is Cancer?

Cancer generally is defined as the unregulated multiplication of specific cells in the body. The word *cancer* actually refers to more than 200 different diseases, but in all cases, certain body cells multiply in an abnormal, unregulated manner.

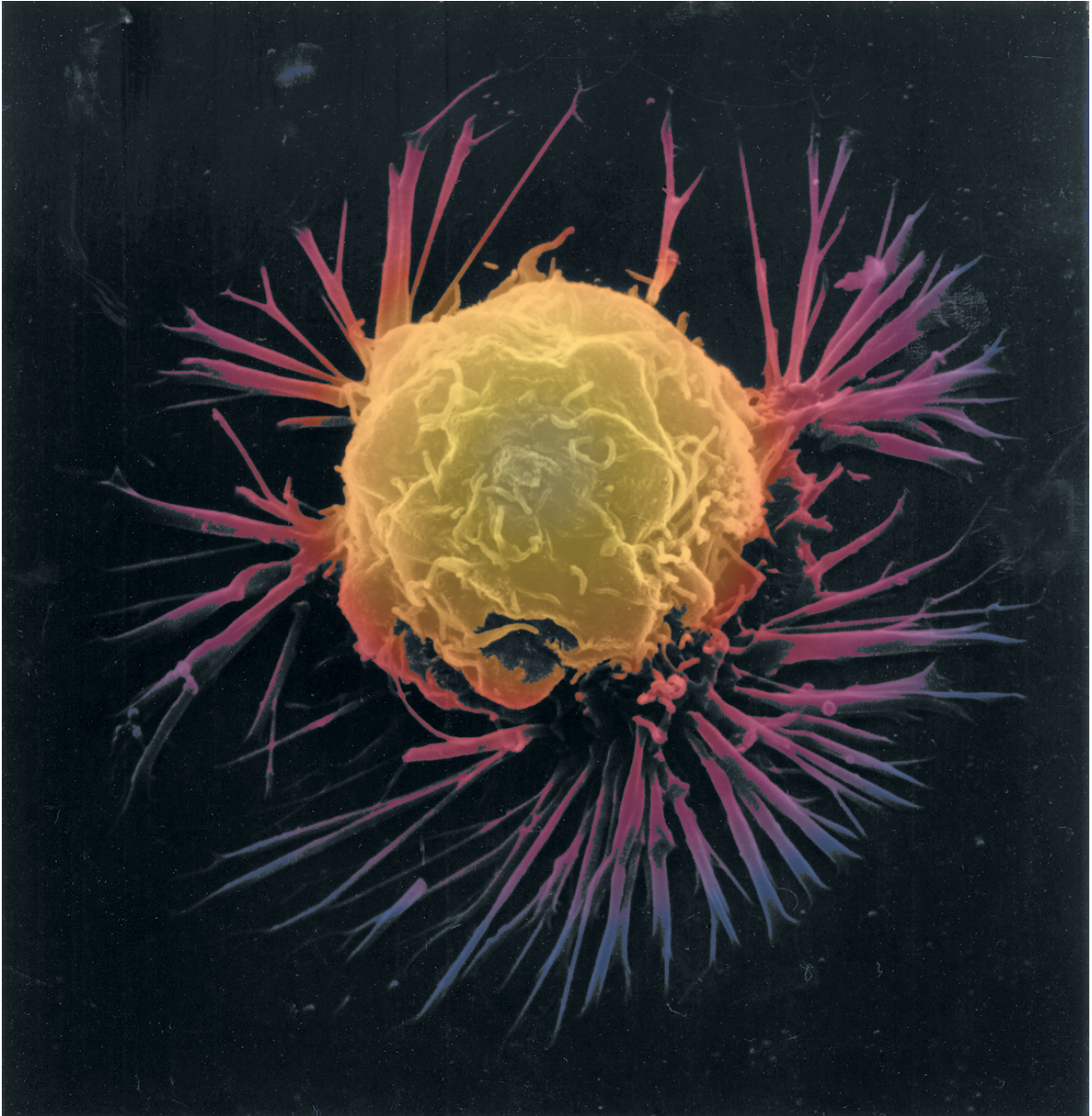
Normally, the growth and reproduction of every cell in the body are regulated; this regulation, in turn, determines the size and functions of tissues and organs. If a normal body cell begins to develop abnormally and reproduces too rapidly, a mass of abnormal cells eventually develops what is called a **tumor**. A tumor usually contains millions of abnormal cells before it can be detected or diagnosed.

If the cells of the tumor remain localized at the site of origin in the body and if they multiply relatively slowly, the tumor is said to be benign. **Benign tumors**, such as cysts, warts, moles, and polyps, do not spread to other parts of the body. Benign tumors usually can be removed and generally are not a threat to life; in fact, a benign tumor weighing several hundred pounds was surgically removed from a woman who recovered fully. Benign tumors cannot regrow if all of the abnormal cells are removed by surgical excision of the tumor or other successful medical treatment.

Malignant tumors are composed of cells that multiply rapidly, have other abnormal properties that distinguish them from normal cells, and invade other normal tissues. In particular, malignant cells may have altered shapes and cell-surface characteristics that contribute to their rapid proliferation. Many malignant cells also have abnormal chromosomes or altered genes, and they manufacture abnormal proteins. The numerous altered properties of malignant cells enable a *pathologist*, a physician who specializes in the causes of diseases, to determine whether the cells removed from a tumor are malignant and to what degree, a process called *staging* the tumor.

The cells of most malignant tumors also undergo **metastasis**, a process in which cells detach from the original tumor, enter the lymphatic system and bloodstream, and are carried to other organs. Once the malignant cells spread to other organs, they develop into new tumors that often grow more rapidly than cells in the original tumor. Metastases and the growth of new tumors in many organs of

the body eventually disrupt a vital body function, which is the cause of death.



Electron Micrograph of a Breast Cancer Cell.

Courtesy of the National Cancer Institute

Cancers are medically classified as *carcinomas*, *sarcomas*, *leukemias*, and *lymphomas* (**Figure 11.2**). Within these major

categories are numerous subgroups that generally describe the organ in which the cancer originates, such as adenocarcinoma of the stomach or small cell carcinoma of the lung. About half of all human cancers originate in one of four organs: the lung, breast, prostate, or colon, which is why so much research is devoted to these particular forms.

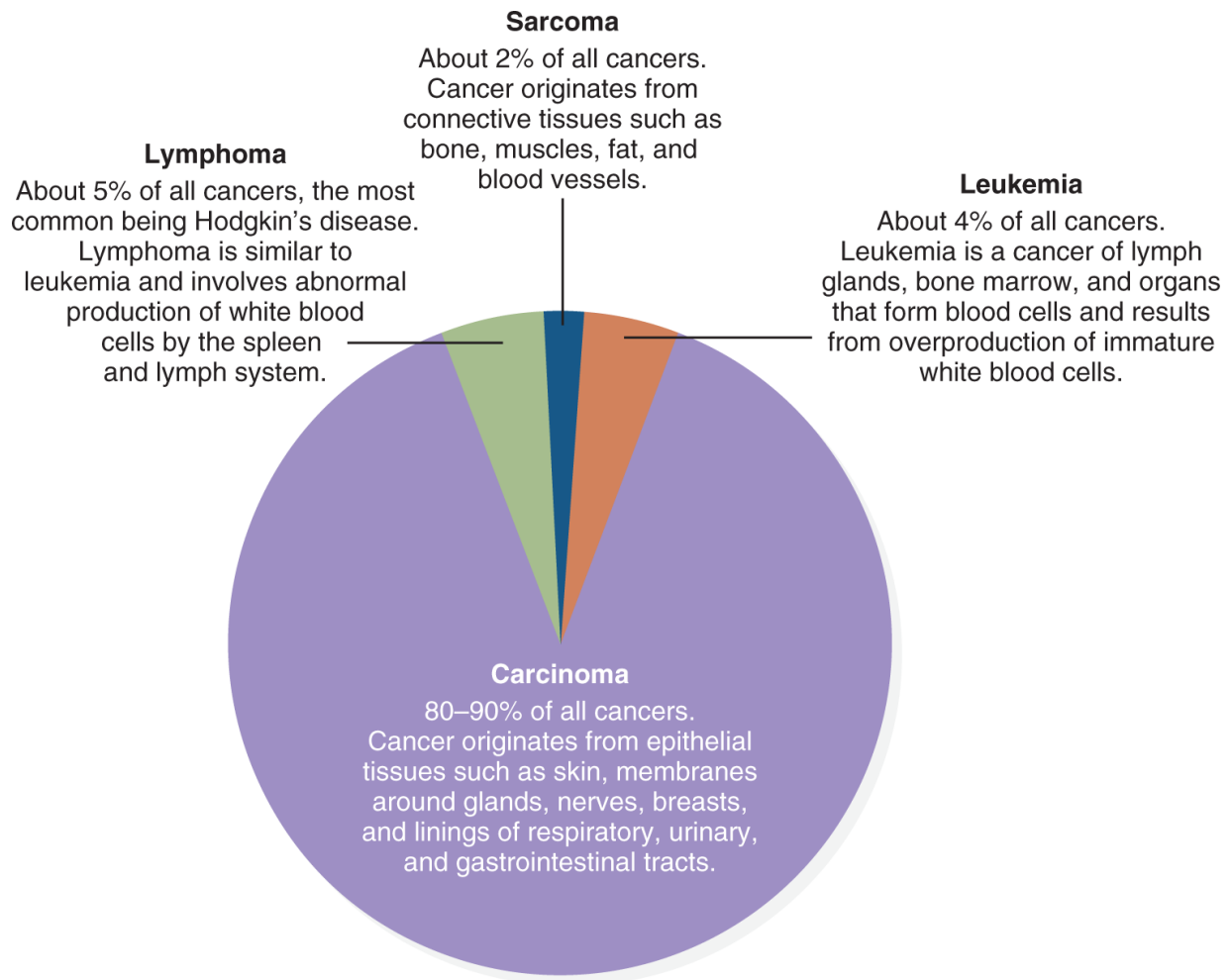


Figure 11.2 Four Major Categories of Cancers and Approximate Frequencies of Occurrence.
Description

Cancer does not develop all at once in a cell. Several changes must occur in the genetic information (i.e., DNA) carried in a single cell before it can become a cancer cell and multiply into a tumor.

Cells change their abnormal growth properties one step at a time; each change pushes the cell further along the spectrum of abnormal development. Not all cells acquire the same changes, nor can anyone predict when the changes will occur. That explains why some cancers develop and grow rapidly and cause death in months, whereas other cancers grow so slowly that the person eventually dies from a cause other than cancer.

Once a tumor has been detected, cells can be removed from it in a procedure called a **biopsy**; the cells are then examined under the microscope by a pathologist. In stage I, cancer cells can be distinguished from normal cells. The cancer cells are still localized (usually referred to as cancer *in situ*) and removal of the tumor usually results in a cure. In stage II, the cancer cells have begun to metastasize and may have migrated to nearby lymph nodes. That is why lymph nodes near the tumor are removed and examined to determine whether cancer cells have spread. By stage III, the cancer cells have spread throughout the body, and tumors may have begun to grow in other organs. In stage IV, tumors are found throughout the body and often are resistant to treatment.

The numbers of deaths from cancer by organ and by sex are shown in **Figure 11.3**. In North America, lung cancer is the leading cause of death in both women and men. Researchers have found that the risk of cancer of the colon and rectum, the third leading cause of death for both men and women, is associated with diets low in fresh fruits and vegetables and high in processed meats.

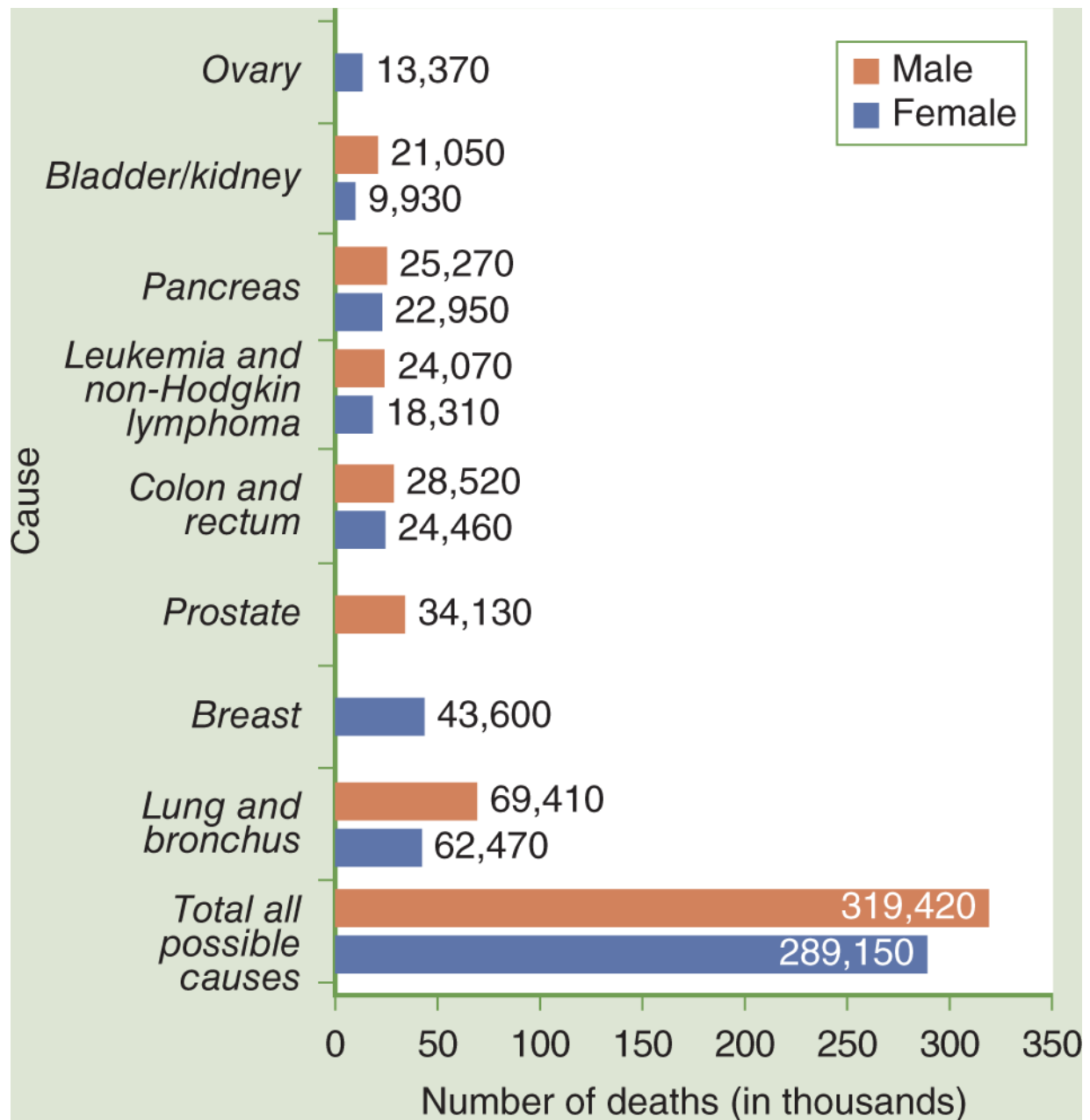


Figure 11.3 Estimated Deaths from Common Cancers, United States, 2021.

Data from American Cancer Society. (2017). *Cancer Facts and Figures*, 2021. Retrieved from <http://www.cancer.org/research/cancer-facts-statistics/all-cancer-facts-figures/cancer-facts-figures-2021.html>.

Description

Causes of Cancer

Most Cancers Are Not Inherited

Many people live in fear of cancer, often because one or more closely related family members have died from some type of cancer. They may believe that cancer is passed on in the genes or that, at least, the susceptibility to cancer is inherited. Neither belief is correct for the vast majority of cancers. However, a persistent fear of developing cancer can generate stress that may weaken the immune system and contribute to the development of disease, including cancer.

Scientific studies indicate that 90% to 95% of *all* cancers, including breast, lung, stomach, colon, skin, or prostate, are *not* inherited from parents except in a few rare families in which members do inherit one or more cancer susceptibility genes.

Confusion about genes often stems from misunderstanding the meanings of the words *genetic* and *inherited*. The two are not synonymous. All of your cells (except for red blood cells) contain exact copies of the chromosomes and genes that were in the fertilized egg from which you developed. The genes in the chromosomes of any cell of your body can be chemically changed by environmental agents such as chemicals in tobacco smoke, industrial chemicals, environmental pollutants, and ultraviolet radiation. These changes may transform cells into cancer cells. Thus, cancer is a genetic disease in that genes are changed in a person's body cells; however, it is *not* an inherited disease because chemically altered genes are not usually passed on from parents. Thus, a parent who acquires cancer cannot pass it on to his or her child.

Even if several close family members have died of cancer, it does not mean that cancer "runs in the family" as an inherited disease. Currently, about 1 of every 4 deaths each year in the United States is the result of cancer. If your grandparents and eight aunts or uncles

have died, probably two or three of them died of cancer simply by chance. If they all smoked cigarettes, it would not be surprising if more than 3 of 10 close relatives died of cancer.

One of the best pieces of evidence showing that most cancers are *not* inherited comes from a study of World War II veterans. The health of 15,000 pairs of identical or nonidentical (fraternal) twin brothers was followed for many years after World War II. No difference was observed in the different twin pairs in the development of cancer—that is, if one identical twin contracted cancer, the other identical twin was no more likely to get cancer than the average person.

Because identical twins possess identical genes (i.e., they are natural clones that developed from the same fertilized egg that split into separate embryos), they should carry identical cancer-causing genes. The fact that identical twins do not *both* develop cancer at significantly higher rates than the average person means that most cancers are *not* caused by inherited genes. For most people, lifestyle (e.g., diet, weight, smoking, drinking alcohol) plays a far greater role in causing cancer than any genes that are passed on from parents.

Cancer Susceptibility Genes

Although cancer as a disease is not transmitted genetically to offspring by parents, about 5%–10% of all cancers are nevertheless influenced by heredity because of the intergenerational transmission of what are called **cancer susceptibility genes**. A cancer susceptibility gene does not cause cancer directly. It increases the risk of a specific cancer in someone who carries that gene. Examples of cancer susceptibility genes are *BRCA1* (BReast CAncer gene 1) and *BRCA2* (BReast CAncer gene 2).

Normally, *BRCA1* and *BRCA2* are genes that help repair damaged DNA, the chemical in cells of which genes are made. Because DNA is the master controller of all cell activity, damage to a section of DNA that controls a cell's reproduction can result in uncontrolled cell replication and growth—that is, cancer. DNA can become damaged by chance during the normal course of cell replication. It can become

damaged by interaction with pollutants and other foreign chemicals that enter the body. It can become damaged by sunlight and high-energy radiation (e.g., gamma rays, X-rays, neutrons) from the environment (and even outer space) that passes into and sometimes through the body. DNA repair genes, like *BRCA1* and *BRCA2*, are involved in fixing damaged DNA, which reduces the risk of cancer.

However, imagine that one day your car won't start, so you get it to a repair shop, only to discover that the mechanic has quit and there's no replacement mechanic in sight. This is akin to what happens when *BRCA1* or *BRCA2* gets damaged and the cell's DNA repair system consequently stops. This increases the risk of a variety of cancers, including breast cancer. About 13% of women in the general population will develop breast cancer sometime during their lives. By contrast, 55%–72% of women who inherit *BRCA1* and 45%–69% of women who inherit *BRCA2* will develop breast cancer by 70–80 years of age because normal DNA damage in those particular genes unleashes cancerous processes that would otherwise be restrained. This is why people who inherit either *BRCA1* or *BRCA2* also are at risk for ovarian and other cancers. Other breast cancer susceptibility genes, identified by abbreviations, are *ATM*, *CHEK2*, *PALB2*, and *TP53*. Other cancer susceptibility genes have been identified as involved in many types of cancer (von Stedingk et al., 2021) ([Table 11.2](#)).

TABLE 11.2 Cancer Susceptibility Gene		
Abnormalities (mutations) in these genes can be inherited. Each abnormal gene may contribute to the development of cancer in a specific organ.		
	Gene	Organ Affected
Breast Cancer	BRCA1	Breast, ovary
	BRCA2	Breast
	p53	Breast, brain

Colorectal Cancer	<i>MSH2</i>	Colon, uterus
	<i>MLH1</i>	Colon, uterus
	<i>PMS1, PMS2</i>	Colon, other
	<i>APC</i>	Colon
Melanoma	<i>MTS1 (CDKN2)</i>	Skin, pancreas
	<i>CDK4</i>	Skin
Prostate Cancer	<i>HPC1</i>	Prostate
	<i>MSR1</i>	Prostate
	<i>AR</i>	Prostate
	<i>CYP1</i>	Prostate
	<i>SRD5A2</i>	Prostate

Many genes that increase the risk of colorectal cancer have been identified, and some of their biological functions in cells also are understood (**Figure 11.4**). If a person inherits an abnormal form of any one of three genes—identified by scientists as *APC*, *MSH2*, or *MLH1*—the risk of colorectal cancer is increased. However, fewer than 5% of all colorectal cancer patients inherit any of these colorectal cancer susceptibility genes.

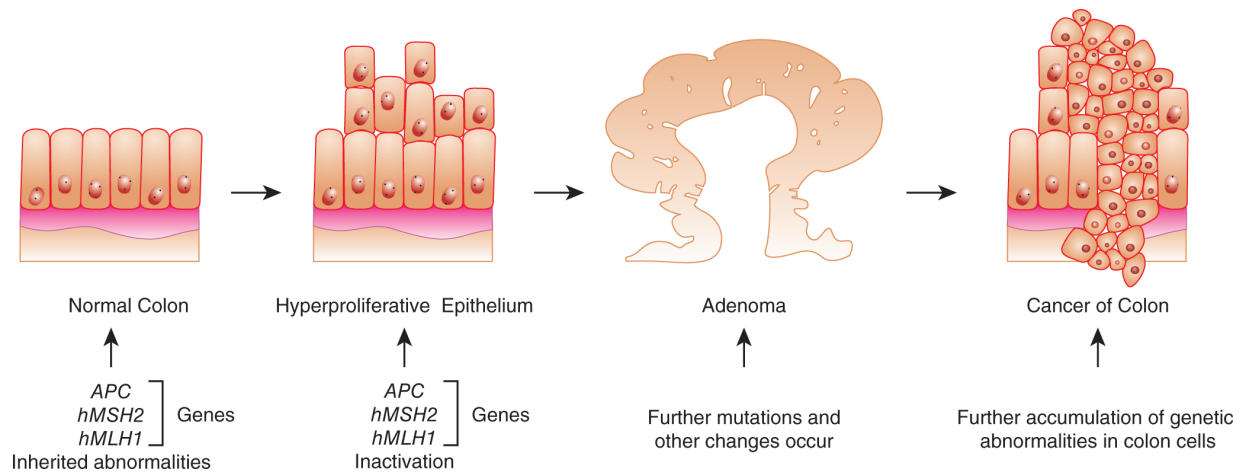


Figure 11.4 Mutant Genes Contribute to Development of Cancer Cells. Changes in several genes can lead to increased risk of colorectal cancer. Abnormalities in *APC*, *MSH2*, or *MLH1* genes can be inherited from parents. Other changes may occur in genes of colon cells during the course of a person's life before development of a cancer. Examination of colorectal cancer cells indicates that most of them have accumulated several genetic changes, either inherited or acquired.

Description

Every cancer is biologically unique, which is the reason that many hospitals and clinics offer personalized cancer treatments. With today's techniques for rapid sequencing of DNA, the specific abnormal genes in a cancer patient's tumors can be identified and treatments tailored for precise biological targets. In addition to more targeted and safer chemotherapy, a variety of revolutionary immunotherapy treatments are becoming available to treat even advanced cases of some cancers.

Environmental Factors That Cause Cancer

The causes of cancer or, more correctly, the risk factors associated with the development of cancer, are numerous and complex. It often is difficult to point to a single cause of a cancer, but certain environmental factors are strongly correlated with the occurrence of particular cancers (**Table 11.3**).

TABLE 11.3 | Environmental and Lifestyle Risk Factors That Contribute to Cancer

Factor	Amount of Risk	Types of Cancer
Nutrition	About <i>half</i> of cancer deaths are caused by nutritional problems: Excess calories Excess fat consumption Obesity Nutritional deficiencies, especially fiber and vitamin A	Cancers of the colon, rectum, stomach, breast, and ovaries
Cigarettes and alcohol	About <i>one-third</i> of cancer deaths are caused by smoking cigarettes and excessive alcohol consumption	Cancers of the lung, pancreas, mouth, larynx, liver, esophagus, and bladder
Occupation	About 5% of cancer deaths are caused by substances in the workplace such as asbestos, benzene, and vinyl chloride	Cancers of the bladder, lung, stomach, blood, liver, bones, and skin
Radiation	About 3% of cancer deaths are caused by ionizing radiation such as X-rays and ultraviolet light	Blood, skin
Other	Other cancer deaths result from heredity, chronic disease, drugs, and infections	Various cancers

Three classes of environmental agents—ionizing radiation, infectious microorganisms (viruses and bacteria), and cancer-causing chemicals (carcinogens)—have been shown to increase the risk of cancer in both laboratory animals and people. Each of these agents increases the risk of cancer by producing chemical changes (**mutations**) in genes in any cell in the body. If a cell undergoes one or more gene mutations, it may begin to multiply rapidly and develop into a tumor. Environmental factors cause mutations and also affect the rate of cancer cell growth deriving from them (**Figure 11.5**).

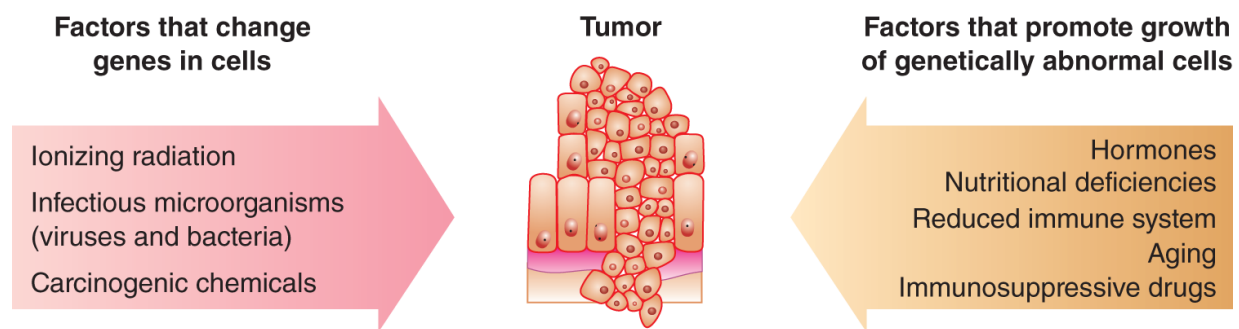


Figure 11.5 Environmental Factors That Cause Cancer. Environmental factors change both genes and the growth properties of cells that may lead to the development of cancer.

Description

Ionizing Radiation

Ionizing radiation consists of X-rays, ultraviolet (UV) light, and radioactivity with sufficient energy to damage cells and chromosomes. The high rate of leukemia among survivors of the Hiroshima and Nagasaki atomic bomb blasts in 1945 leaves no doubt that radioactivity increases the risk of cancer.

The nuclear reactor accident at Chernobyl in Ukraine in 1986 also released large amounts of radioactivity, particularly radioactive iodine, strontium, and cesium, into the atmosphere. Not only was the region around the reactor affected but also radioactive fallout occurred over much of Europe. In some countries, milk and crops were so contaminated that they had to be destroyed. Some of the radioactivity was detected in countries as distant as the United

States and Japan. Workers dispatched to clean up the site developed immune system cancers from exposure to the radiation.

In 2011, a catastrophic earthquake and tsunami caused major damage to several nuclear power plants in Fukushima, Japan. Considerable amounts of radioactivity were released over several weeks that resulted in the evacuation of thousands of people from the area because it was thought to be unsafe. This accident reinforced the concern that living near nuclear power plants, especially ones at risk from earthquakes or floods, is a major health concern for people around the world. Germany, Belgium, Spain, and Switzerland plan to phase out all nuclear power plants by 2030.

Ionizing Radiation and Skin Cancer

The most common source of ionizing radiation in nature is UV radiation in sunlight. Exposure to sunlight is the primary cause of all forms of skin cancer. Because children and young adults can spend many hours in the sun, people acquire as much as 80% of their lifetime UV exposure by age 20. The degree of exposure to sunlight during childhood largely determines the risk of skin cancer later in life.

The skin consists of several layers and kinds of cells. The upper layer (*epidermis*) consists of flat *squamous cells*, and the bottom layer contains *basal cells*. Interspersed among the squamous and basal cells are *melanocytes*, cells that give skin its pigmentation, a major survival advantage to people living in tropical latitudes. People with relatively more melanocytes have darker skin and are less susceptible to skin cancer than are light-skinned people.

Two factors contribute to the risk of skin cancers among North Americans. First, sunbathing and booth-tanning. Second, the continuing depletion of the ozone layer results in more ultraviolet radiation reaching Earth's surface; it is the UV radiation in sunlight that causes mutations in skin cells that may lead to cancer. Reducing exposure to sunlight reduces the risk of skin cancer.

Sunlight contains ultraviolet radiation (UVR) along with visible light that we detect with our eyes (UVR is invisible). UVR can penetrate skin cells, damage DNA, and initiate chemical changes in genes (mutations) that may eventually develop into a skin cancer. The two most dangerous forms of ultraviolet radiation in sunlight are UVA and UVB. Sunlight consists of about 95% UVA and 5% UVB; tanning lamps emit mostly UVB.

The three kinds of skin cancer are **basal cell carcinoma**, **squamous cell carcinoma**, and **melanoma**. Each kind of skin cancer originates from different kinds of skin cells. In the United States, about 1 million cases of skin cancer are diagnosed every

year; about 2.5 million cases are diagnosed annually worldwide. Basal cell carcinoma and squamous cell carcinoma are usually not life-threatening, and the abnormal cells can be removed surgically or by freezing. Melanoma (cancer of melanocytes) is a highly dangerous form of skin cancer, and once it has spread the cancer is difficult to cure. About one death every hour in the United States results from melanoma; the incidence of melanoma today is about 20 times greater than it was in the previous century, largely because people have been increasing their exposure to sunlight and to indoor tanning lamps or beds.

Medical treatment of melanoma includes surgical removal of the cancer in the early stages; drugs to stop the growth of cancer cells; radiation therapy, which uses high-energy X-rays or other types of radiation to kill cancer cells or keep them from growing; and immunotherapy, which uses patient's immune system to fight cancer.



(a)



(b)



(c)

Any unusual growth on the skin should be checked by a health professional to determine whether it is a form of skin cancer. (a) Basal cell. (b) Squamous cell. (c) Melanoma.

(a) Photograph by Kelly Nelson. Courtesy of the National Cancer Institute; (b) Photograph by Bob Craig. Courtesy of the Centers for Disease Control and Prevention; (c) Courtesy of the National Cancer Institute.

Most Skin Cancers Are Preventable

The number of people in the United States with various types of skin cancer, especially melanoma, is increasing. This need not be because skin cancers are among the most preventable of all cancers. The primary cause of most skin cancers is excessive exposure to sunlight and tanning lamps. The best way to prevent skin cancer caused by sunlight is to follow the **WAR** rule:

- **W**ear protective clothing.
- **A**void the sun between 10 AM and 3 PM.
- **R**egularly apply sunscreen with an SPF greater than 15 when outdoors, even on cloudy days. Sunscreen should be reapplied every few hours; more often if swimming or exercising.

Protecting children from sunburn and overexposure is especially important because it is the lifetime exposure to UV that is associated with skin cancers in later life. By age 65, about one American in two has had some form of skin cancer. The ozone layer in Earth's upper atmosphere filters out much of the sun's UV light; thinning of the ozone layer in recent years markedly increases the danger of overexposure to sunlight. Unless more people follow the WAR rule, the incidence of skin cancers is expected to continue to rise in the years ahead.

The Environmental Protection Agency and the National Weather Service offer a daily email advisory to anyone wanting to know the UV levels in their area. UV intensity is rated on a point scale of 1 to 11; 6 or higher means that the UV intensity is high for the area and that exposure should be limited. The UV advisory can be accessed at epa.gov/sunsafety/uv-index-1.



Signs of Melanoma

To protect yourself from melanoma, remember these *ABCD rules* when examining moles (small dark spots or growths) on your body for any changes. If you suspect anything, consult a physician immediately.

- **Asymmetry**—one half of a mole looks different from the other half.
- **Border irregular**—the edges of a mole are ragged or indistinct.
- **Color**—the pigmentation in the mole is uneven.
- **Diameter**—any mole that is larger than the diameter of a pencil or that has increased in size.

Ionizing Radiation and Diagnostic Imaging (Scans)

Because it is highly beneficial in medical diagnosis, there is concern over the risk of cancer from too much diagnostic medical imaging, especially *computerized tomography* (CT) scans (National Cancer Institute, 2021). In 2019, more than 91 million CT scans were performed in the United States, a 3% increase since 2018. The annual increase in the use of CT scans and other forms of diagnostic radiation imagery is expected to continue. Unfortunately, financial considerations drive some of this rise. A doctor could be faulted—and sued for malpractice—for not getting a scan even if the patient's medical presentation does not indicate one. CT scanners are expensive machines, so hospitals and diagnostic clinics have a financial incentive to perform as many scans as possible to pay for them, even if some of them are diagnostically unnecessary.

The amount of ionizing radiation received by a patient undergoing a CT scan varies greatly, depending on the area of the body being imaged. It is helpful to understand the dose of radiation received if it is expressed in terms of the average background radiation to which we are all exposed. A chest CT scan requires the equivalent of 2 years' worth of natural background radiation; a CT scan of the head uses about 8 months' worth of background radiation. If a person receives several CT scans for a variety of medical conditions (perhaps for injuries in a car crash), the overall radiation dose is quite high and increases the risk of cancer. Of particular concern is the growing use of CT scans on children. A child's cells are still growing and reproducing and are at greater risk from exposure to radiation than are adult cells; thus, they are at greater risk of developing cancer later in life.

The radiation exposure from CT is higher than that from standard X-ray procedures, but the increase in cancer risk from one CT scan is still small. Not having the procedure can be much more risky than

having it, especially if CT is being used to diagnose cancer or another serious condition in someone who has signs or symptoms of disease.

People need to be aware of the dangers of unnecessary CT, X-ray, and other scans recommended for themselves and their children. They should discuss with their medical providers and dentists the rationale for any recommended imaging procedure and ask if it is crucial to the diagnosis. To become better informed about medical imaging technologies and cancer risk, go to www.xrayrisk.com.

Cancer-Causing Viruses

In 1911, Peyton Rous, a scientist working at the Rockefeller Institute in New York, showed that cancer could be produced in chickens by injecting them with a virus isolated from chicken tumors. Since then, other viruses called **tumor viruses** have been found in animals such as mice, cats, and monkeys.

A few viruses are associated with an increased risk of cancer in humans: hepatitis B and C viruses (liver cancer), papillomavirus (genital and cervical cancer), human T-cell leukemia–lymphoma virus (leukemia and lymphoma), and Epstein-Barr virus (cancer of the nose or pharynx). Infection by HIV, the virus that causes AIDS, is associated with the development of a particular cancer called *Kaposi's sarcoma*. And a bacterium that is found in the stomach and causes ulcers (*Helicobacter pylori*) is associated with an increased risk of stomach cancer, one form of lymphoma, and some types of pancreatic cancer.

Chemical Carcinogens

A **chemical carcinogen** is an environmental substance that can interact with cells to initiate cancer, usually by chemically altering the chromosomes or genes in cells. One or more altered genes can change the growth properties of a cell and cause it to become a cancer cell.

In some industries, workers have cancers that almost never arise in the general population. For example, **mesothelioma** is a rare form of lung cancer that only occurs among persons exposed to asbestos fibers, principally asbestos miners, construction workers, and children whose schools still have asbestos insulation in the walls. Workers exposed to vinyl chloride, the starting material for polyvinyl chloride pipes and other products, can develop a rare form of liver cancer not found in the general population. Fortunately, with current occupational and safety regulations, these types of occupational cancers occur infrequently.

Some industrial and agricultural chemicals are tested to determine their cancer-causing potential. Unfortunately, many thousands more chemical substances already in use have not been adequately tested. Of the thousands of chemical substances that have been tested, many have been found to be carcinogenic and should be avoided if at all possible (**Table 11.4**).

TABLE 11.4	Examples of Occupational Cancers
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Chemical or Physical Agent	Cancer Type	Exposure of General Population	Examples of Workers Frequently Exposed or Exposure Sources
Arsenic	Lung, skin	Rare	Insecticide and herbicide sprayers, tanners, oil refinery workers
Asbestos	Mesothelioma, lung	Uncommon	Brake-lining, shipyard, insulation, and demolition workers
Benzene	Myelogenous leukemia	Common	Painters, distillers and petrochemical workers, dye users, furniture finishers, rubber workers
Diesel exhaust	Lung	Common	Railroad and bus-garage workers, truck operators, miners
Formaldehyde	Nose, nasopharynx	Rare	Hospital and laboratory workers; manufacture of wood products, paper, textiles, garments, and metal products
Hair dyes	Bladder	Uncommon	Hairdressers and barbers (inadequate evidence for customers)
Ionizing radiation	Bone marrow, several others	Common	Nuclear materials, medicinal products and procedures
Mineral oils	Skin	Common	Metal machining
Nonarsenic pesticides	Lung	Common	Sprayers, agricultural workers
Painting materials	Lung	Uncommon	Professional painters
Polychlorinated biphenyls	Liver, skin	Uncommon	Heat-transfer and hydraulic fluids and lubricants, inks, adhesives, insecticides
Radon (alpha particles)	Lung	Uncommon	Mines; underground structures; homes
Soot	Skin	Uncommon	Chimney sweeps and cleaners, bricklayers, insulators, firefighters, heating-unit service workers
Synthetic mineral fibers	Lung	Uncommon	Wall and pipe insulation, duct wrapping

Description Description

The total number of cancers attributable to industrial chemicals is small compared with those caused by tobacco and diet; however, cancers caused by industrial chemicals are preventable or avoidable. Before you accept a job it might be wise to determine what chemicals you will be exposed to for long periods.

By far, tobacco smoke is the deadliest chemical carcinogen because it is responsible for 90% of cases of lung cancer, the deadliest of all cancers worldwide. In the United States, lung cancer is the number one cause of cancer deaths for both men and women. More women die each year from lung cancer than from breast cancer. About 235,000 new lung and bronchus cancers are

diagnosed in the United States every year, which accounts for about 11% of all cancers.

The survival rate of lung cancer patients is dismal; among all patients, after being diagnosed only 7% live another 5 years. Medical costs of treating lung cancer are about \$40 billion annually, making it the costliest of all cancers.

The risk of lung cancer varies significantly among ethnic and racial groups. African Americans and native Hawaiians are at highest risk, especially at lower levels of cigarette smoking (less than a pack a day). White Americans, Japanese Americans, and Latinos are about half as likely to get lung cancer as the other two groups at comparable levels of smoking. The reasons for racial and ethnic differences are not clear but may have to do with inherited lung cancer susceptibility genes that vary among groups of people.

The rate of lung cancer in many nations is rising rapidly as more and more people take up cigarette smoking, often as a result of unregulated tobacco advertising. Women in developing countries begin to smoke at early ages to appear sophisticated and because of peer pressure. International efforts are under way to reduce smoking around the world among young people.

Endocrine Disruptors

Endocrine disruptors are natural or industrial chemicals that mimic or interfere with the body's intrinsic endocrine (hormone) system. Endocrine disruptors are found in many everyday products, including some plastic containers, liners of metal food cans, detergents, flame retardants, food, toys, cosmetics, and pesticides. Dozens of different hormones participate in controlling normal human physiology, principally by switching on and off particular functions. Because endocrine disruptors are chemically similar to natural hormones, when they get into the body via food, water, skin, or breathing, they can interact with chemically similar hormone sites in the body and cause malfunctions of various kinds, including cancer.

Endocrine disruptors that chemically resemble male and female sex hormones have been linked to increased cancer risk. For

example, bisphenol-A (BPA), an industrial chemical used in the production of polycarbonate plastics for food and beverage containers and epoxy resin-coated metal products, has been linked to increased risk of breast cancer in women and prostate cancer in men. BPA enters the body in food and drink and circulates in the blood to hormone-sensitive tissues in breast and prostate, where it interferes with the regulation of cell reproduction and hence causes cancer. Many countries have banned the use of BPA in the manufacture of baby bottles and children's food packaging. And many countries are considering total bans of the chemical.

Endocrine disruptor pesticides called *organochlorines* also have been linked to increased risk of breast cancer (Eve et al., 2020). In the 1960s and 1970s, Israel had one of the highest incidences of breast cancer in the world. In 1976, Israel banned all chlorinated pesticides and made it illegal for milk products to have any detectable pesticide residues. In the years following the pesticide ban, rates of breast cancer declined dramatically. These findings support the hypothesis that pesticides acting as endocrine disruptors can be a major contributor to breast cancer.

It is impossible to avoid all exposure to endocrine disruptors because they are everywhere in the environment. Ways to lessen the cancer risk from endocrine disruptors include avoiding chlorinated pesticides by consuming organic (that is, pesticide-free) fruits and vegetables, dairy products, and grains; avoiding cleaning products with endocrine disrupting chemicals (check the product label); and not eating out of plastic containers.

I am not who I think I am. I am not who you think I am. I am who I think you think I am.

—Anonymous Student

Breast Cancer

Worldwide, breast cancer is the second most common and deadliest cancer in women. In the United States, the yearly incidence of new cases of breast cancer are about 281,000, with around 43,600 breast cancer deaths. Both men and women can develop breast cancer, but it is rare among men.



Self-Care Practice: Gratitude

Gratitude is a feeling of thankfulness or appreciation associated with the realization that you've been helped, supported, or affirmed by someone or something outside yourself. Many studies show that gratitude fosters satisfying social relationships by motivating generosity, compassion, and forgiveness. It also reduces social anxiety and loneliness. Gratitude is associated with vitality, joy, pleasure, optimism, and happiness, all psychological traits that reduce the biological stress response that includes tissue-damaging inflammation.

One way to enhance the capacity for gratitude is to set aside a few minutes each day or a few days a week to note on paper, in your phone, or mentally at least one thing that happened recently for which you are grateful. Alternatively, you can keep a journal to write a few sentences each day or two about those things for which you are grateful. You can do the list or the writing as the last thing you do before going to bed. Doing it this way can help you pay attention to what happens in your life so you can write about later.

Increased weight, lack of exercise, and alcohol consumption contribute to an increased risk of breast cancer. Research does not support the view that the amount of fat in the diet increases the risk of breast cancer. Other factors that increase the risk of breast cancer among women to varying degrees are the following:

- mother who had breast cancer before age 60;
- first menstruation before age 14;
- first child born after age 30;
- no biological children;
- menopause after age 55;

- benign breast disease;
- estrogen replacement therapy after age 55;
- consuming more than 3 ounces of alcohol a day;
- inheritance of *BRCA1*, *BRCA2*, and other susceptibility genes; and
- exposure to endocrine disruptors.

A **mammogram** is an X-ray image of the breasts that is used to detect the presence of any abnormal breast tissue.



Abortion Does *Not* Increase Risk of Breast Cancer

In 2002, the National Cancer Institute (NCI) website announced that scientists had found no association between abortion and subsequent risk of breast cancer. Some members of Congress raised a hue and cry, and the information was removed from the NCI website.

NCI then assembled more than a hundred scientific experts from various fields to review the data. Only one member disagreed with the otherwise unanimous conclusion: "There is no association between abortion and the risk of breast cancer" (Couzin, 2003).



Mammograms can detect breast cancer at an early stage and improve chances for successful treatment.

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A Healthy Lifestyle Helps Prevent Breast Cancer

Living healthfully—for example, maintaining a normal body weight—is effective in reducing a woman’s risk of breast and other cancers. Other ways that help prevent breast cancer include maintaining a low-fat diet, consuming adequate amounts of fresh fruits and vegetables, engaging in physical activity, and limiting alcohol consumption. Women with a diagnosis of breast cancer can increase their chances of survival by engaging in physical activities such as walking briskly for 3 to 5 hours a week.

Treating Breast Cancer

For too many years, surgical removal of one or both breasts along with underlying tissue—a procedure called a *radical mastectomy*—was the recommended treatment for women with a diagnosis of breast cancer. In recent years, a surgical procedure called a *lumpectomy*, in which only the tumor itself is removed, has been shown to be as effective as a mastectomy in terms of long-term survival among most women with early-stage breast cancer. However, if cancer cells were found in underarm lymph nodes, these also were removed, usually resulting in a painful, often complicated recovery. For more than a century, it had been assumed that the presence of cancer cells in lymph nodes signaled that the cancer would spread to other parts of the body and survival would be reduced. But now chemotherapy or radiation therapy are recognized as successful treatments for breast cancer.

Modern DNA tests also can help determine the optimal treatments for an individual woman's breast cancer. By determining the cancer cells' particular molecular markers, a chemotherapy regime most likely to succeed can be administered. However, some DNA tests that detect specific breast cancer genes can bring disheartening news.

Research supports the use of integrative therapies for specific clinical indications during and after breast cancer treatment (Greenlee et al., 2017). For example, music therapy, meditation, stress management, and yoga are recommended for reducing anxiety, stress, and depression and other mood disorders and improving overall quality of life. Acupressure and acupuncture are recommended for reducing chemotherapy-induced nausea and vomiting. No strong evidence supports the use of ingested dietary supplements to manage breast cancer treatment-related side effects.

Wearing sunglasses that block at least 99% of all UV light is important for protecting eyes. Polarized lenses block glare but do not necessarily block UV unless the label on the glasses says so. *Photochromic* lenses that darken in bright light also may not block UV light; always read the label. Over time, eye exposure to UV can cause cataracts.



What Do Indoor Tanning Lamps and Cigarettes

Have in Common?

Each causes cancers and premature death.

Tanning lamps cause twice as many cases of skin cancer (about 400,000 per year) than cigarettes cause lung cancer (about 240,000 cases per year). And although tans are considered by many to be a symbol of health, vitality, and sexual attractiveness, wrinkled, blotched skin and early death from cancer seem a high price to pay for those presumed social rewards.

Brazil and Australia have outlawed indoor tanning salons. In 2015, the U.S. Food and Drug Administration proposed legislation, which never came to pass, to ban the use of tanning beds for individuals under age 18. Currently, issues of health and safety of tanning salons and beds are dealt with by state and local governments (if at all).

Consider the following facts:

- More than half of the persons who use tanning lamps regularly are likely to develop a basal cell carcinoma before age 40.
- Tanning lamps greatly increase the overall risk of melanoma, the most deadly form of skin cancer.
- Many states have passed laws banning persons younger than age 18 from tanning salons or from purchasing tanning lamps.
- Using tanning beds or lamps to increase vitamin D in the body is extremely dangerous.
- About 7.8 million women and 1.9 million men in the United States use tanning lamps.

Do yourself a favor—steer clear of tanning lamps.



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Diet and Cancer Risk

Many studies show that the risk of certain cancers is strongly influenced by diet (Key et al., 2020). For example, high consumption of alcohol and processed meats such as bacon, sausage, lunch meats, and hot dogs increases the risk of cancer whereas low consumptions of fresh fruits, vegetables, and whole grains lessens the risk of colon cancer.

Despite the scientific uncertainty over what specific foods increase the risk of cancer, certain dietary choices may help to prevent cancer (Table 11.5). Most of these dietary recommendations also help boost the immune system, which is a major defense against cancer. B vitamins, vitamin C, and folic acid have been shown to boost the immune system and, as a consequence, may also help destroy cancer cells. These substances can be taken as supplements but also are readily available in fresh fruits and vegetables.

TABLE 11.5 | Dietary Recommendations to Help Prevent Cancer

About 50% of all cancers are thought to derive from poor nutrition.		
Substance or Foods That Help Prevent Cancer	Effect on Cancer Risk	Advice
Fiber	Helps decrease colon and rectal cancer	Obtain fiber from vegetables, fruits, whole grains
Cruciferous vegetables (broccoli, cauliflower, brussels sprouts)	Phytochemicals in these vegetables may detoxify cancer-causing chemicals	Eat more; raw or undercooked is best

Allium vegetables (onion, garlic, chives)	Sulfur-containing chemicals in allium vegetables may help prevent cancer	Eat more
Beta-carotene (15 mg), vitamin E (400 IU), and selenium (50 µg)	A daily supplement reduced cancer (mainly stomach and esophagus) in a large Chinese population	Use supplements in moderation; selenium in high doses is toxic
Folic acid	Deficiency in this vitamin increases genetic damage that may contribute to cancer	Supplement if diet is deficient
Green tea	Reduced esophageal cancer in Chinese population	Most tea drunk in United States is black tea; try green tea
Shiitake mushrooms	Extracts of shiitake mushrooms reduced tumors in laboratory animals; also reduces blood cholesterol	Add to diet

Our ancestors foraged for their food. They collected and ate seeds, roots, fruits, and vegetables and rarely ate meat. Thus, the diet we consume today, filled with excess sugar, salt, fat, and meat, may be incompatible with the body chemistry we have inherited from our ancestors. The modern diet, heavy with processed foods, may result in the accumulation of toxic chemicals or an insufficient amount of some essential nutrients found in fresh fruits and vegetables, nuts, and grains.

Cancer Treatments

Treatments for cancer are surgery, **radiation therapy**, **chemotherapy**, and **immunotherapy**. Surgical removal of all or as much of a tumor as possible is considered the standard treatment for cancer, particularly if the tumor is small and cells have not spread throughout the body. If even a few cancer cells remain, however, they may grow into new tumors, which is the reason that surgery, such as mastectomy, often removes a great deal of tissue in addition to the tumor.

If there is evidence that tumor cells have spread, or if some of the tumor could not be removed surgically, then radiation or chemotherapy, or both, are used to try to destroy the remaining cancer cells. Because radiation therapy and chemotherapy destroy normal cells as well as cancer cells, only limited amounts of each treatment can be administered.

Hundreds of anti-cancer drugs are available, many of which are quite effective for treating a specific cancer. However, many of anticancer drugs are extremely expensive, costing thousands of dollars annually; total drug treatment for cancer can total hundreds of thousands of dollars, far more than most cancer patients and their families can afford without highly comprehensive or government health insurance.

Cancer patients often become desperate and depressed about their condition, the pain of treatments, and the prospect of death. In this state, some patients turn to unconventional therapies and promises of “miracle” cures (**Table 11.6**). Many cancer patients choose alternative therapies in hope of a cure when conventional medicine has nothing to offer. Although unconventional therapies may be helpful or at least produce more peace of mind, patients and their families need to be wary of practitioners who make unfounded claims for unlicensed drugs and unproven therapies (see the Health Tip box “Don’t Be Fooled by ‘Miraculous’ Cancer Cures”).

TABLE 11.6**Unproven Cancer Therapies**

Many cancer patients who are desperate or who have exhausted all medical treatments turn to unconventional therapies for which benefits are scientifically unproven.

Therapy	Rationale
Metabolic therapy	Toxins and wastes in the body cause cancer. Treatments remove cellular poisons and detoxify the body.
Herbal remedies	Herbs have natural, sacred, curative properties not known to science.
Megavitamins	High doses of vitamins kill cancer cells and rejuvenate the body.
Diet therapy	Special diets (grape, macrobiotic, shark cartilage) restore balance to the body and cure the cancer.
Electronic devices	Electrical or magnetic energy harmonizes the life forces and kills the cancer cells.

Cancer Immunotherapies

The body's own immune system can attack cancer cells anywhere in the body. Methods to enable the immune system to work better against cancer are called *immunotherapies*. For example, the currently available HPV vaccine induces the immune system to manufacture antibodies against HPV, thus providing protection against cervical cancer. Scientists are working on a more targeted immunotherapy in which immune system T cells are induced to recognize and attack a patient's specific cancer cells.



Don't Be Fooled by "Miraculous" Cancer Cures

Most people who are diagnosed with cancer become depressed or angry, especially if their doctor is pessimistic about the outcome or cannot offer hope of a cure. Understandably, people who cannot be helped by conventional medicine (and many who can) often turn to an alternative that offers a cure for advanced cancer. Such alternatives include nutritional therapies, immune therapies, light therapies, and religious or spiritual cures.

Most of the alternative cancer therapies are designed to take money from desperate patients and their families. Information on any alternative cancer therapy can be found on quackwatch.com. This site has links to many other sources of reliable information. With alternative cancer therapies, remember the adage “If it sounds too good to be true, it probably is.”

In 2011, the drug Yervoy was approved for treating patients with advanced melanoma. In about 20% of those treated, tumors disappeared, and the cures seem permanent (Piore, 2017). Yervoy was the first approved immunotherapy that uses *checkpoint inhibition*. Some cancers grow and spread by blocking the immune system. Checkpoint inhibition drugs remove a cancer’s ability to block the immune system, allowing an effective anticancer immune response to proceed. Several other checkpoint inhibitor drugs are now available, and more are in development.

Other immunotherapies use drugs to “mark” cancer cells to make it easier for the immune system to find and destroy them. Another kind of cancer immunotherapy called *CAR-T therapy* involves removing T cells from the blood of a person with cancer, modifying them in a laboratory or clinic so they are better able to find and destroy cancer cells, and then placing the modified cells back into the body.

Cancer immunotherapy took a positive turn in 2017 with the approval of a checkpoint inhibitor that can treat cancers caused by a specific genetic defect that results in a wide range of cancers. The genetic defect hampers the cell’s ability to repair DNA that has been damaged by radiation or chemicals. Failure to repair DNA damage causes the accumulation of mutations, some of which turn normal cells into cancer cells. Prior to this, drugs were approved to treat only a specific cancer. In this case, the drug was approved to treat *any* cancer that is caused by the same genetic defect. In tests, the drug was effective against 12 different types of cancer in 77% of patients

with defects in DNA repair. As many as 60,000 cancer patients a year may benefit from this new approach to cancer treatment (Saey, 2017).

More harm is done by fools through foolishness than is done by evildoers through wickedness.

—Sufi proverb

Coping with Cancer

A diagnosis of cancer raises serious problems for the patient and for family and friends. Often the patient enters a state of disbelief or shock. The family has to cope with new problems. The patient must face surgery or other treatment. Along with treatment, the patient usually must deal with fear of death, anger at the disease, loss of income, changes in living habits, and, above all, the uncertainty of the outcome, which may last for months or years. These are some of the reasons that coping with cancer can be difficult. Stress and emotional upset can depress the normal functions of the immune system. There also is evidence that hostile feelings, resentment, deeply felt personal loss, and feelings of hopelessness may be impede successful coping with cancer.

The coping strategies for dealing with the emotional distress resulting from cancer, AIDS, and other serious diseases are similar. They all depend on using the mind in positive ways. The effectiveness of any therapy and the ability to cope with a life-threatening illness depend on focusing the mind on ways to enhance the healing process. Meditation and relaxation techniques are important in reducing stress. Learning how to use visual imagery can help with the effectiveness of treatments. Along with mental relaxation techniques, the mind can focus on images and suggestions that may help the immune system fight and destroy cancer cells.



Visualization Helps Healing

As director of biofeedback research at the Menninger Clinic in Topeka, Kansas, Dr. Patricia Norris (2012) documented many cases in which mental imagery and visualization were used successfully to complement traditional medical treatment. Dr. Norris cites eight specific characteristics that help to make mental imagery and visualization effective as a healing tool, specifically with regard to cancer:

1. *Make the visualization personal.* The images must be self-generated. Images that are created by the practitioner and not the patient appear to be ineffective.
2. *Make the imagery egosyntonic.* This means that the image must fit the values and ideals of that person. If, for example, the individual is pacifistic, then combative or warlike imagery will undermine the effectiveness of this type of treatment.
3. *Make the imagery positive.* Negative imagery reinforces negative thoughts, which are not conducive to healing. As an example, Norris notes that sharks, as a healing image, are not a good idea.
4. *Take an active role in the imagery.* Rather than imagining watching the imagery on a movie screen, you must feel the sensations of your images in the first person. You must have a sense that what you are seeing is happening inside your body, not “out there somewhere.”
5. *Make the image anatomically correct and accurate.* Knowing exactly what body region and physiological system are in a disease state will dictate the type of imagery used. Consequently, you need to know whether to access the central nervous system or the immune system. Norris states that more than one image can be used in the healing process.
6. *Be constant and use dialogue.* *Constancy* means to be regular in generating your imagery. Norris suggests three 15-minute sessions per day, with intermittent shorter sessions throughout the day. When you feel pain, your body is communicating to you. She suggests making pain your friend. In the dialogue style of self-talk, she suggests thanking the pain for making you aware of the problem so that you may be able to fix it. Finally, she suggests “destroying” a tumor with its permission. Respond with love. Make peace with your body.
7. *Create a blueprint.* The concept of the blueprint is a strategy. A blueprint visualization is like time-lapse photography where a flower (symbolizing a tumor) is shown to bloom within seconds and then closes up again and fades away. An example would be to see the construction of a building, starting from the hole in the ground to opening day where you are cutting the ribbon at the front entrance.
8. *Include the treatment in the imagery.* Norris has found that patients who use mental imagery with chemotherapy treatment and radiation do better than those who “fight” these medical procedures. She notes that it helps to have benevolent feelings versus ambivalent feelings toward the treatment. She suggests one mentally “welcome the

treatment into the body.” Consider the treatment as a guest in your house. Based on her patient research, she offers the following examples:

- a. *chemotherapy*—a gold-colored fluid that healthy cells, acting as a bucket brigade, pass along to the cancer cells, which in turn drink up the chemotherapy.
- b. *radiation treatment*—a stream of silver energy aimed at the cancerous tumor. Ask the white blood cells to move away or to shield themselves and act like mirrors to reflect the radiation toward the cancer cells, and then watch the cancer cells die.

Coping with cancer requires courage and conviction. A cancer patient (and the patient’s family and friends) must not give up hope, despite what the statistics predict or what physicians say about the prognosis. The patient must believe that the cancer can be subdued and work toward that end. For many people, coping with cancer is a transforming experience and gives renewed meaning to life.

Critical Thinking About Health

1. Consider this hypothetical case of a female college student. Several women in her family, including her grandmother and an aunt, died of breast cancer before they reached 65 years of age. She is only 21 years old but is extremely concerned about her own risk of developing breast cancer. She decides to be tested for the breast cancer susceptibility genes *BRCA1* and *BRCA2*, even though her physician explains that no medical treatment short of prophylactic mastectomy is available. The genetic test is positive for gene *BRCA1*, and her risk of breast cancer is significantly higher than for other women who do not have this gene. Discuss, from your own perspective, what this woman should now do to preserve her health. Gather as many facts as you can on breast cancer and the effects of these susceptibility genes.
2. Make a list of all the factors you can think of that increase the risk of developing cancer. Order the items in your list from highest risk to lowest in your judgment. Are any of the risk factors relevant to your life? If so, describe how you could modify your lifestyle or behaviors to reduce the risk of developing cancer.
3. The “war against cancer” is fought by physicians and scientists in two fundamentally different ways. On the one hand, medical research tries to discover better treatments for all forms of cancer. On the other hand, epidemiologists and other researchers emphasize prevention because we understand many of the environmental factors that cause cancer. Reducing exposure to risk factors could prevent as many as half of all human cancers. In your judgment, which of these positions is correct? Or do you believe both positions are equally valid? Develop facts and arguments that substantiate your views and write a report of your conclusions.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Cancer is actually many different diseases that share the property of abnormal and unregulated cell multiplication. Although some cancers are caused by inheriting harmful variants of specific genes, about 80% to 90% of all cancers are the product of environmental factors—smoking cigarettes or breathing polluted air, exposure to ionizing radiation such as sunlight or nuclear waste, infection by certain viruses, and exposure to pesticides, heavy metals, petrochemicals, and certain drugs. As with other chronic diseases, maintaining proper body weight, eating a variety of fresh foods, and exercising will help prevent cancer cells from developing in the body. Although fashionable among young and old, acquiring a tan by exposure to the sun or from tanning lamps can greatly increase the risk of skin cancers. Many cancers can be treated successfully with modern drugs, but the risk of cancer recurrence is always present.

Breast cancer is of great concern to women of all ages. Regular mammograms can help women detect breast cancers at early stages, thus making more treatment options available. Certain groups of women, particularly those of Jewish ancestry, are at much higher-than-average risk of developing breast cancer because of susceptibility genes that they may have inherited. Hispanic women, on the other hand, may be of lower-than-average risk. Genetic tests are available for numerous cancer susceptibility genes, including two that are specific for breast cancer. Prevention is the best way to avoid a diagnosis of cancer. Avoid eating foods that may cause cancer such as charbroiled meats, smoked meats and fish, and fruits and vegetables that may contain pesticide residues. Avoid chemical fumes and polluted air if possible. Do not breathe smoke from tobacco, outdoor grills, or forest fires.

HIGHLIGHTS

- *Cancer* refers to a number of different diseases, all of which share the common property of abnormal, unregulated cell replication in the body.
- Dietary factors and environmental agents such as smoking and sunlight act on the genetic material in cells to cause chemical changes that may initiate a tumor, which is a mass of abnormal cells.
- Cigarette smoking is responsible for about one-third of all cancers, especially lung cancer.
- The principal environmental agents that cause cancer are ionizing radiation, tumor viruses, carcinogenic chemicals, and, possibly, endocrine disruptors.
- If everything known about cancer prevention were practiced, up to one-half of cancers would not occur; thus, cancer is largely a preventable disease.
- Only 5% to 10% of cancers are caused by genes that have been inherited. The genetic changes in body cells that result in cancer are not passed on to children because these genetic changes have not occurred in sperm or eggs.
- The treatments for cancer include surgery, radiation, chemotherapy, and immunotherapy. The goal of all three cancer treatments is the removal or destruction of as many cancer cells as possible.
- Recovery from cancer depends on good nutrition, positive attitudes, healing mental images, and medical treatment

appropriate for the particular cancer. A healthy, active immune system also is an essential component in cancer prevention and recovery.

- Dietary deficiencies or excesses are responsible for about one-half of all cancers.
- Overexposure to sunlight causes skin cancer, which is on the increase.
- Significantly reducing cancer requires major changes in people's lifestyles, including more attention to a healthy diet, elimination of tobacco use, limiting alcohol consumption, and reducing exposure to intense sunlight and chemical carcinogens.

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KEY TERMS

cancer:

unregulated multiplication of cells in the body

tumor:

a mass of abnormal cells

benign tumors:

tumors whose cells do not spread to other parts of the body

malignant tumors:

tumors whose cells spread throughout the body

metastasis:

the process by which cancer cells spread throughout the body

biopsy:

removal of cells from a tumor for examination under a microscope

cancer susceptibility gene:

gene responsible for increasing the risk of developing a particular type of cancer

mutations:

permanent changes in the genetic information in a cell; only mutations in sperm and eggs are inherited

ionizing radiation:

radiation, such as X-rays, that can damage cells and cause cancer; also used to treat cancer

basal cell carcinoma:

a form of skin cancer that usually can be removed surgically

squamous cell carcinoma:

cancer of the top layer of skin; most are curable if removed early

melanoma:

a particularly dangerous form of skin cancer

tumor viruses:

viruses that infect cells, change their growth properties, and cause cancer

chemical carcinogen:

a chemical that damages cells and causes cancer

mesothelioma:

a form of lung cancer caused by asbestos

endocrine disruptors:

are natural or industrial chemicals that mimic or interfere with the body's intrinsic endocrine (hormone) system

mammogram:

X-ray picture used to detect tumors in the breast

radiation therapy:

use of high-energy radiation, such as X-rays, to kill cancer cells and treat some forms of cancer

chemotherapy:

use of toxic chemicals to kill cancer cells and treat some forms of cancer

immunotherapy:

medically enhancing the body's immune system to fight cancer



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CHAPTER 12

Genetics and Health



Dollars & Health Sense

The Cost of Treating Cystic Fibrosis



Wellness Guide

My Family Medical History

Fetal Alcohol Syndrome

Determining If You Are at Risk for Bearing a Child with Genetic Abnormalities

Saving a Life with a Life

Self-Care: Empty Your Cup

LEARNING OBJECTIVES

1. Describe the functions of DNA, genes, and chromosomes.
2. Describe several inherited diseases caused by chromosomal abnormalities.
3. List several chemicals that cause birth defects and what they were used for.
4. Explain how a familial pattern of disease differs from a hereditary (genetic) disease.
5. Describe the symptoms of fetal alcohol syndrome and how the syndrome can be prevented.
6. Explain the role of genetic counseling in preventing hereditary diseases.
7. Explain the procedure of amniocentesis.
8. Define genetic discrimination and describe its consequences for people.
9. Discuss how gene therapy and embryonic stem cells may be used to treat and cure disease.

Genetics is a feature of all living things. The word *genetics*, derived from the Greek word *genesis*, was coined a little more than 100 years ago to refer to the biological entities responsible for the transmission of hereditary traits, what we now call **genes**, from parent to offspring. A century of much astounding research later, we now know *genetics* refers to processes fundamental to the proper functioning of individual organisms, the passage of hereditary traits between generations, and the mechanism of the evolution of three billion years of life on Earth. With genetics being so fundamental to multiple aspects of life, it is understandable that it plays key roles in health, healing, and well-being.

When the sperm from your father joined with the egg from your mother, you inherited from each parent about 20,000 genes. Beginning with conception and continuing throughout life, those genes directed and controlled the development, functioning, and repair of your body's tissues and organs. Your genes control the processes that keep you alive, your particular disease

susceptibilities, to a large extent your overall health and life expectancy, and your ability to produce offspring.

People through finding something beautiful, think something else unbeautiful. Through finding one man fit, judge another unfit.

—**Lao Tzu**, *The Way of Life*

Genes are arranged in linear fashion along threadlike structures called **chromosomes**, which are found in the nucleus of cells. Each chromosome, depending on its size, contains thousands of different genes. The information for life carried in the genes along a chromosome is contained in a chemical substance called **DNA (deoxyribonucleic acid)**. Together, these genes determine the uniqueness of each human being (**Figure 12.1**). (Identical twins share identical genes but differ in their traits to some extent because of environmental effects on the expression of their genes.) Because chromosomes occur in pairs, each person carries two copies of each gene; these may be identical in information or differ slightly from one another.

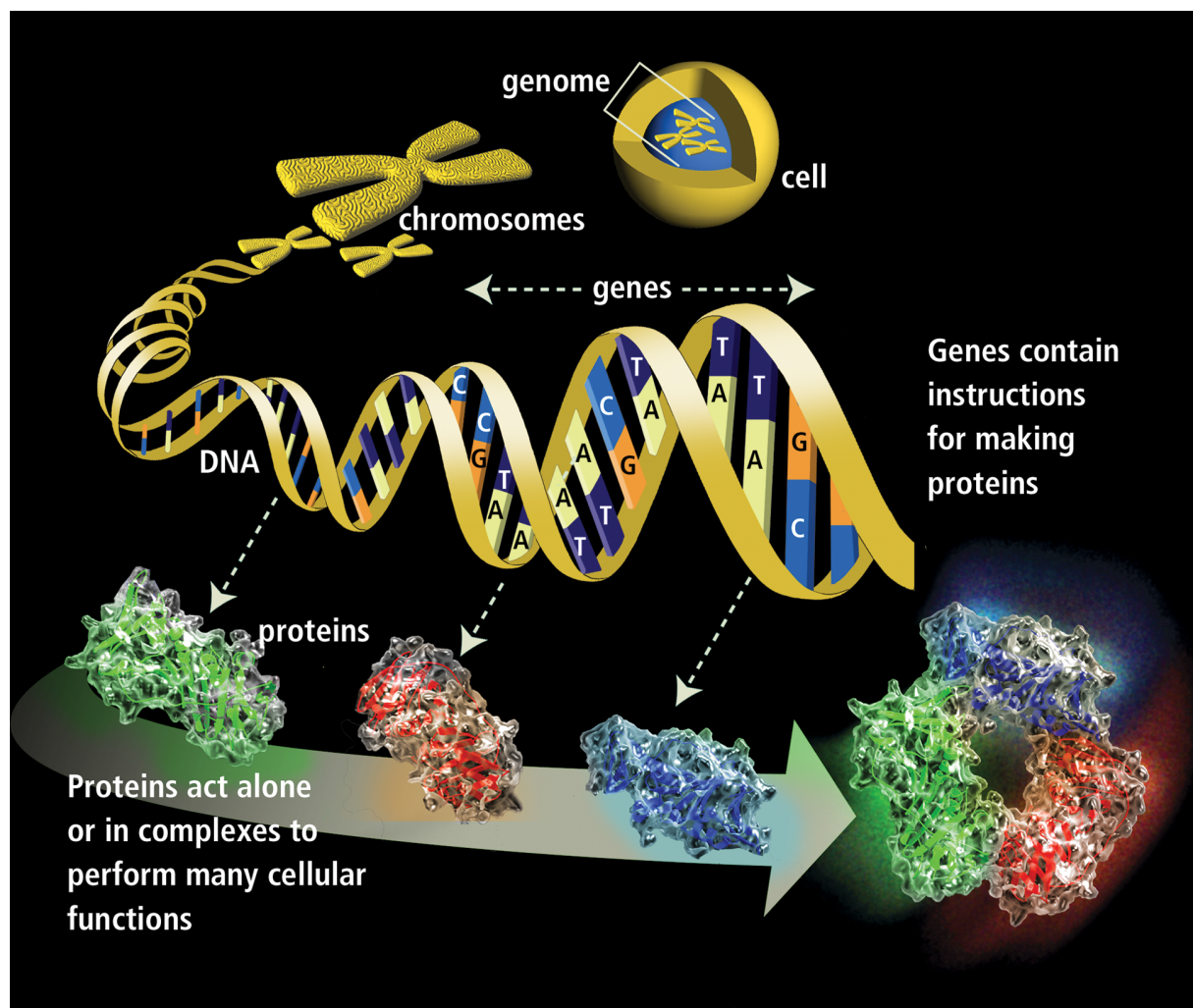


Figure 12.1 DNA—The Molecule of Life. The diagram shows the relation among DNA, genes, chromosomes, and proteins in all cells of the body. Chromosomes contain the hereditary chemical DNA. Specific short segments of DNA contain genes, most of which carry information for the synthesis of specific proteins. The information in each gene is copied into a molecule of ribonucleic acid (RNA), which is then translated into a specific protein that the cell needs.

Courtesy of the U.S. Department of Energy Genomic Science program,
<http://genomicscience.energy.gov>

Description

Every cell in the human body (except red blood cells) carries 23 pairs of chromosomes (a total of 46). The chromosomes of each pair are structurally unique from the chromosomes in the other pairs.

Twenty-two of the chromosome pairs are designated by a number from 1 to 22. The 23rd pair, called the *sex chromosomes*, differs between males and females. These chromosomes are designated with the letters “X” and “Y.” Males possess an X and a Y chromosome; females possess a pair of X chromosomes.

During the maturation of sperm and ovum, the number of chromosomes is halved to 1–22 plus a sex chromosome. Halving the number of chromosomes in sperm and egg ensures that the species number of chromosomes—46 in the case of humans—is maintained from generation to generation. At fertilization, the father’s 23 chromosomes and mother’s 23 chromosomes combine to become the fertilized egg’s full complement of the chromosomes. The parental chromosomes in the fertilized egg are replicated into every cell of the fetus during development; skin, liver, heart, lung, and brain cells all contain identical sets of chromosomes.

Most genes contain the information needed to make large, complex molecules called **proteins**. There are many thousands of types of proteins, each having an important role in the structure, function, and regulation of the body’s tissues and organs. There are proteins that carry out the work of cells, proteins for immunity and protection, proteins for transporting chemicals throughout the body, proteins that are chemical messengers within the body, and proteins that provide the body’s architecture. Each type of protein has at least one gene responsible for determining its specific structure and function.

Even though every cell in the body contains the identical set of genes in its 46 chromosomes, cells and organs differ in the body because not all of those genes are expressed. Most are silenced by specific biological processes. Those that are not silenced become expressed as proteins that comprise different tissues. The orchestrated turning on and off of genes in cells is the key to development and correct functioning of the body throughout life. The flow of information from DNA in chromosomes to functional proteins in cells is the same in all living organisms, attesting to a common cellular history.

Human chromosomes have a characteristic shape, size, and banding pattern that can be seen when they are stained with dyes and examined under the light microscope. A photograph of a preparation of chromosomes arranged as pairs is a **karyotype** (Figure 12.2). Each of the 23 different human chromosome pairs can be distinguished and identified.

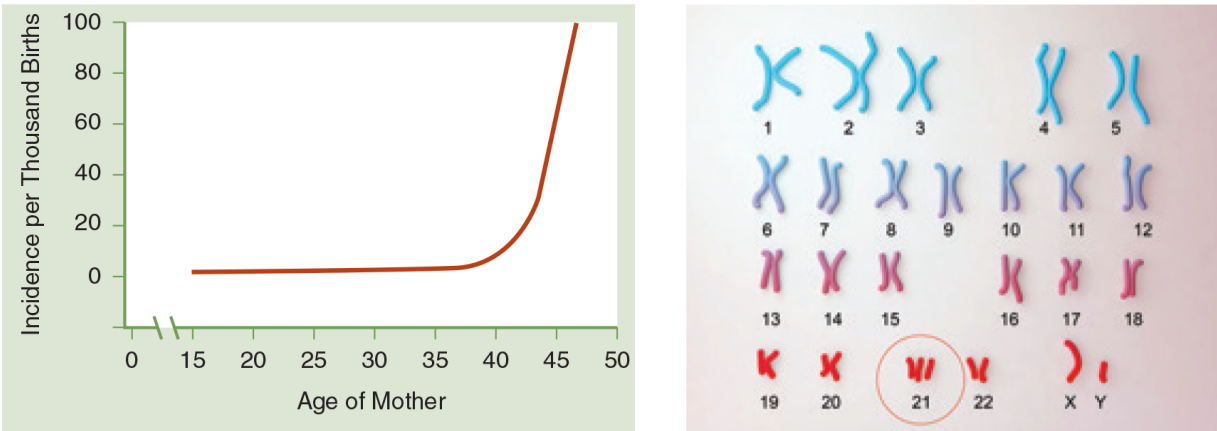


Figure 12.2 Karyotype of Individual with Down Syndrome. Note three copies of chromosome 21. Frequencies of children born with Down syndrome are shown in relation to the age of the mother. At age 35, the risk of this particular chromosomal abnormality begins to rise sharply.

Left: Data from Hook, E. B. (1984). Chromosomal Abnormality Rates at Amniocentesis and in Live-Born Infants. *Journal of the American Medical Association*, 249, 2034–2038; Right:

© Kateryna Kon/Science Photo Library/Getty Images.

Description

The chemical makeup of a gene is precise. Were it not that way, the specific protein derived from a gene would probably not function as the body requires. Chemical changes in genes in sperm or egg can be passed on to offspring, whereas chemical changes in genes in nonreproductive body cells are not heritable. Various situations can permanently change the chemistry of a gene, which in turn could affect a protein's integrity and hence a body function. Gene-changing situations include random errors that occur during cell replication, chemical damage from ionizing radiation (see below), and gene

interaction with environmental pollutants or viruses. Genes with altered chemistry are called *gene variants*; the chemical alterations are called *mutations*. A variant can be benign or pathogenic. The term *variant* is increasingly being used in place of the term *mutation*.

A variation in the chemistry of the gene responsible for the production of a protein called *lactase* affected the course of human evolution. The function of lactase is to digest *lactose*, the principal sugar in mother's milk. The gene for producing lactase is situated on human chromosome 2, and almost all babies are born with it in an activated form so they can digest breast milk or cow's milk. At some point between ages 2 and 5, most people in the world lose the ability to digest lactose because the body inactivates the lactase-producing gene on chromosome 2. If someone with an inactivated lactase gene ingests milk products, he or she can experience highly unpleasant bloating, diarrhea, and abdominal cramps. The inability to digest lactose is called **lactose intolerance**.

Biologists explain the inactivation of the lactase gene in most older children and adults by pointing out that, until quite recently in human evolution, people did not consume milk after weaning. In this way, the body could conserve matter and energy for other uses by not producing an unnecessary enzyme. About 10,000 years ago, people in northern Europe and a few tribes in Africa began to raise cows, goats, sheep, and other animals for their milk, which became an important part of the diet. Variations (mutations) in the chemistry of lactase genes arose among these milk drinkers that permitted continued lactase enzyme production for life, and this genetic change was passed from one generation to the next. Today, populations around the world vary from being almost completely lactose intolerant (Southeast Asians) to being almost completely lactose tolerant (Scandinavians). (Note: Lactose intolerance is not a true milk allergy; milk allergy is an immune response to milk proteins).

Chromosomal Abnormalities

Errors may occur in the structure of chromosomes when sperm or eggs are developing. These errors can result a sperm or egg having too few or too many chromosomes; other forms of physical chromosomal abnormalities also can occur. These chromosomal abnormalities can result in hereditary diseases (see [Table 12.1](#)). About 20% of all human conceptions have a chromosomal abnormality of some kind. The majority of fetuses with chromosomal abnormalities abort spontaneously early in a pregnancy, sometimes even prior to a woman knowing she is pregnant.

TABLE 12.1

Chromosomal Abnormalities

Some genetic diseases are associated with an extra or missing chromosome. Most abnormalities in chromosome number (more or less than the normal 46) are incompatible with survival; in most cases, affected babies die before birth. However, abnormalities in chromosomes 21, X, or Y are compatible with survival but usually produce physical and mental abnormalities.

Genetic Disease/Disorder	Chromosomal Defect	Incidence per Live Births	Symptoms
Turner's syndrome (female)	Missing X	1/1,000	Absence of ovaries, short stature, underdeveloped breasts
Klinefelter's syndrome (male)	Extra X	1/1,000	Small, undeveloped testes, sterility, intellectual disabilities
Down syndrome (male or female)	Extra chromosome 21	1/700	Physical abnormalities, intellectual disabilities, heart defects
XXX syndrome (female)	Extra X	1/1,000	No clinical abnormalities, height above average, possible intellectual disabilities
YYY (male)	Extra Y	1/1,000	No clinical abnormalities, height above average, controversy over "criminal" tendency

Description

Viewing cells removed from a fetus, child, or adult can identify chromosomal abnormalities such as the extra chromosome 21 that causes *Down syndrome* (Figure 12.2). This serious inherited birth defect occurs in about 1 in every 700 babies born in the United

States. However, the rate begins to increase in women around age 35 and increases dramatically after age 40. Because of the increase in Down syndrome with increased maternal age, all pregnant women over age 35 are advised to undergo genetic tests of fetal cells (see section on prenatal testing) to determine whether they are carrying a fetus with Down syndrome. If a test for Down syndrome is positive, a woman can decide whether or not to carry the pregnancy to term.

The extra chromosome 21 carried in all cells of individuals with Down syndrome causes heart defects, altered facial features, and intellectual disabilities. With modern medical care, the life expectancy of a person with Down syndrome is 40 to 50 years. However, caring for a Down syndrome person beyond childhood can tax families both emotionally and financially. Eventually, most individuals with Down syndrome are placed in special living situations with trained caregivers.

Congenital Anomalies (Defects)

Most American babies are born healthy. However, about 3% to 4% of newborns have an observable **congenital (birth) defect**—an anomaly in some aspect of the body's structure or functioning that occurred during development in the mother's uterus. Congenital anomalies are caused by one or more of the following factors:

- Presence of an abnormal chromosome or abnormal number of chromosomes,
- A chemical error in one or more genes inherited from parents that alters body structure or functions
- The effect of toxins, drugs, or other environmental factors on normal fetal development.

Each newborn is examined immediately after birth for any observable physical abnormalities. Such anomalies are not necessarily inherited, although abnormal genes passed from parents to child may play some role. Most congenital anomalies are caused by a complex interaction of genes and environmental factors. Examples of congenital defects are cleft lip, cleft palate, and spina bifida (cleft spine), which result from developmental abnormalities in the formation of the oral cavity and the spine, respectively.

Spina bifida is a congenital anomaly that affects 1 of every 1,000 newborns. It occurs during fetal development when one or more spinal vertebrae fail to close and the spinal cord and nerves bulge through the cleft, forming an easily damaged, fluid-filled sac. The protruding spinal nerves are vulnerable to paralysis-causing damage and also to life-threatening infections.

The most serious congenital defect of the nervous system is *anencephaly*, which refers to extremely abnormal brain development. Affected babies are either stillborn or die soon after

birth. Surgery can repair some of the damage resulting from spina bifida; however, nothing can be done for anencephaly.



My Family Medical History

Directions

Make a copy of the accompanying chart. Mark an "X" in a column to indicate the occurrence of a particular disease in a family member. Keep a copy with your medical records. For any "X" in your chart, research any possibility that the disease has some degree of inherited component.

	Disease						If Deceased, Age at Death	Cause of Death
	<i>Cancer</i>	<i>Diabetes</i>	<i>Heart disease</i>	<i>Hypertension</i>	<i>Stroke</i>	<i>Other</i>		
Father								
Mother								
Brother								
Brother								
Sister								
Sister								
Father's father								
Father's mother								
Father's brother or sister								
Mother's father								
Mother's mother								
Mother's brother or sister								

Description

Supplementing a pregnant woman's diet with the vitamins folic acid and B₁₂ dramatically reduces the risk of spina bifida and other birth defects. Women who plan to become pregnant should take 400 micrograms per day of folic acid before and after becoming pregnant. Most commercial flour and cereals are supplemented with folic acid. Adequate intake can reduce the risk of spina bifida by as much as 70%.

Teratogens

Any environmental agent that causes a developmental anomaly is called a **teratogen** (Table 12.2). Many environmental agents such as prescription and illegal drugs, viral and bacterial infections, alcohol, and cigarette smoke can act as teratogens (from the Greek, “to produce a monster”) during pregnancy and may cause abnormal development in a fetus. With a little care, many teratogens can be avoided, thereby increasing the likelihood of a healthy baby. In particular, smoking cigarettes and drinking alcohol should be avoided by any woman who is pregnant or attempting to become pregnant. Alcohol is concentrated when crossing the placenta so that even one or two drinks can lead to high alcohol levels in the fetus and affect its development (See Wellness Guide “Fetal Alcohol Syndrome”).

TABLE 12.2 Teratogens	
Environmental agents (e.g., infectious viruses and other microorganisms, chemicals, medicines) can act as teratogens and cause birth defects. Many agents in addition to those listed below are suspected of causing abnormal development of the fetus.	
Environmental Agent	Effects
Accutane (acne drug)	Spontaneous abortion, stillbirth, malformation of the brain and heart
Alcohol	Growth deficiencies, intellectual disabilities
Antithyroid drugs	Thyroid defects
Carbamazepine	Neural tube defects
Cocaine	Fetal death, nervous system and genital abnormalities

Environmental agents (e.g., infectious viruses and other microorganisms, chemicals, medicines) can act as teratogens and cause birth defects. Many agents in addition to those listed below are suspected of causing abnormal development of the fetus.

Environmental Agent	Effects
Cytomegalovirus, herpes simplex virus, varicella zoster virus, Zika virus	Growth abnormalities, intellectual disabilities
Diethylstilbestrol (DES)	Masculinization of female, abnormalities of vagina and cervix, risk of vaginal cancer
Ionizing radiation	Growth deficiencies, intellectual disabilities, organ malformation (depending on dose)
Lithium carbonate	Heart and blood vessel defects
Methotrexate and etretinate	Prescription drugs that cause severe birth defects
Nonsteroidal anti-inflammatory drugs	Circulation defects
Phenytoin	Central nervous system defects
Polychlorinated biphenyls	Growth deficiencies, pigment abnormalities
Poor nutrition during fetal development	Growth deficiencies, intellectual disabilities
Rubella virus (German measles)	Heart and eye abnormalities, intellectual disabilities
Tetracycline (antibiotic)	Teeth and bone abnormalities
Thalidomide	Limb malformation
Tobacco smoke	Growth deficiencies, increased risk of sickness and death soon after birth
Warfarin	Central nervous system defects

One particularly tragic example of a teratogen is the drug *thalidomide*, originally intended for the treatment of epilepsy but

ultimately found to be an effective treatment for the nausea and vomiting—so-called morning sickness—experienced by many pregnant women. Before its wise use, the drug had been tested for toxicity in pregnant laboratory animals without incident, so it was assumed to be safe in humans. However, it wasn't. Thalidomide is *not* safe for any woman who is pregnant. Thalidomide interferes with normal development of the bones of the arms and legs of a fetus and causes other developmental abnormalities and even death. The drug was never approved for sale in the United States and most countries ban its use during pregnancy.

However, further research showed that thalidomide (trade name, Thalomid) could successfully treat skin lesions associated with leprosy. The drug now comes with a strong warning advising doctors not to prescribe the drug for any condition for which it is not approved or for women who might become pregnant. The lesson from thalidomide is that women who may become pregnant should not take any drug—prescription, over-the-counter, or illegal—in order to protect a fetus should they become pregnant .

Hereditary Diseases

A **hereditary (genetic) disease** results from the following sequence of events. An abnormal gene (the chemistry of which has been altered) is passed to a child from one or both parents. As a result of inheriting the abnormal gene (or genes), a malfunctioning protein (or proteins) is produced or possibly even missing completely. For example, if a protein involved in muscle structure and function is abnormal or missing, muscles can develop abnormally. Several forms of muscular dystrophy are inherited in this way. If a protein necessary for bone formation is abnormal, short stature, or dwarfism, results. In the disease hemophilia, a chemical called factor VIII, required for normal blood clotting, is abnormal as a result of an altered gene on an X chromosome. Without clotting, ruptures in blood vessels can be life-threatening due to blood loss. Phenylketonuria (PKU) is an inherited disease caused by malfunctioning of a protein needed to digest the amino acid

phenylalanine, an essential nutrient in food. If excess phenylalanine in the blood is not broken down, it accumulates in tissues and causes abnormal brain development and intellectual disabilities.



Fetal Alcohol Syndrome

Consumption of alcohol in any amount during pregnancy increases the risk of a fetal alcohol spectrum disorder, the most common form being **fetal alcohol syndrome (FAS)**. This condition is diagnosed if an infant has certain characteristic abnormal facial features, growth reduction, and neurodevelopmental abnormalities.

Although most babies with FAS are born to women who consume large amounts of alcohol during pregnancy, even moderate drinking during pregnancy increases risk. Thinking that an occasional drink during pregnancy cannot cause any harm is still a gamble. Nine months is a long time between drinks for someone who is used to drinking, even occasionally. Women who are light drinkers before becoming pregnant (about one drink per day) find it easier to give up alcohol than women who are heavy drinkers (three or more drinks per day). Despite the advice of prenatal professionals, public health messages, and warnings on alcoholic beverage containers and in restaurants, the number of newborns with FAS is about 40,000 per year.

Life is not a matter of holding good cards, but of playing a poor hand well.

—Robert Louis Stevenson

Sickle cell disease is another example of an inherited condition. It occurs when an individual inherits from each parent abnormal copies of the hemoglobin gene. The abnormal genes produce abnormal hemoglobin proteins, large molecules in the blood responsible for carrying oxygen to all cells in the body. The abnormal hemoglobin proteins tend to stack, causing the red blood cells that carry them to become crescent or sickle shaped (hence the name of the disease) instead of biconcave discs characteristic of normal red blood cells.

The crescent-shaped red blood cells clog small blood vessels, producing many symptoms of oxygen deprivation, including pain.

Sickle cell disease first arose in tropical, malarial regions of the world. In a quirk of evolution and natural selection, the presence of one abnormal hemoglobin gene helps protect individuals against infection by the parasite that causes malaria. Those who inherit one copy of the abnormal hemoglobin gene are said to have sickle cell trait; they have no symptoms of sickle cell disease because their other normal hemoglobin gene makes sufficient normal hemoglobin to keep them well. Also, they are less likely to die from malaria compared those who carry two abnormal copies of the hemoglobin gene.

In the United States, approximately 900,000 persons have sickle cell disease, mostly Americans of African descent whose ancestors acquired the sickle cell gene in Africa. Worldwide, as many as 275,000 babies are born annually with sickle cell disease.

Drugs, transfusions, bone marrow and stem cell transplants have been mainstay treatments for sickle cell disease for many years. In 2021, scientists reported curing two people with sickle cell disease by changing the abnormal hemoglobin gene they were born with into a fully functioning one using the gene-editing technique called *CRISPR* (Frangoul et al., 2021).

Familial Diseases

Sometimes a disease is said to “run in the family,” which means that members of a family are at higher risk of developing a particular disease compared with the average risk in the general population (**Table 12.3**). For example, families share the same water, food, and air, any one of which may contain harmful or toxic substances. When parents have a poor diet, children usually do also. To appreciate the difference between an inherited disease and one that “runs in the family,” consider these examples. Being a Muslim or a Catholic runs in families, as does being a Republican or a Democrat, but these traits clearly are not determined by any inherited genes. Allergies, obesity, or alcoholism may run in the family, but this does not mean

that these diseases are always inherited. Allergies, alcoholism, or obesity may run in families, but this does not mean these diseases are always inherited.

TABLE 12.3 | **Increased Risk of Certain Diseases and Disorders Among Children When One Parent Is Affected**

In the list below, genes may be involved to some degree, the number of genes conferring risk, or the extent of the genetic contribution, is basically unknown. In all cases, environmental factors also are involved.

	Lifetime Risk (%)	
	<i>General Population</i>	<i>One Parent Affected</i>
Alcoholism (men)	10	40
Alcoholism (women)	3–5	12–20
Alzheimer's	5–10	10–20
Colon cancer	6	12–18
Diabetes, type 2	3–7	10–15
Depression, bipolar	1–3	9–27
Dyslexia	5–10	30–60
Psoriasis	1–2	25
Rheumatoid arthritis	1	5
Schizophrenia	1	10

In contrast to some familiar diseases, hereditary diseases are *always* caused by abnormal chromosomes or genes. However,

determining whether a disease or physical abnormality is inherited is not a simple matter. Many birth defects are caused by infections, teratogens, or other environmental factors, in addition to abnormal genes. This is the rationale for testing newborns for the presence of abnormal genes, a process called **newborn screening**. Newborn screening began in the United States in the 1960s with tests for PKU. Over the years, other reliable tests have been developed for relatively common inherited diseases. The American College of Medical Genetics has identified screening procedures for more than 50 inherited disorders, some of which are extremely rare. The number of inherited disorders for which newborns are tested varies widely by state. Some states test for as few as three inherited disorders; other states test for as many as 40. For more information on newborn screening, check the website of the U.S. National Institute of Child Health and Human Development (<https://www.nichd.nih.gov/health/topics/newborn/conditioninfo/disorders>).

The U.S. Department of Health and Human Services (HHS) recommends that all newborns be screened for inherited health conditions. To that end, HHS maintains a list of conditions for screening called the *Recommended Uniform Screening Panel* (RUSP) (<https://www.hrsa.gov/advisory-committees/heritable-disorders/rusp/index.html>). Each state decides which conditions newborns will be screened for. Most states screen for the conditions on the RUSP. Some screen for more and some less than recommended.

One of the most important newborn screening tests is for abnormalities in a gene on the X chromosome called *fragile X mental retardation* (FMR1). Because males carry only one X chromosome inherited from their mothers, only boys are affected by fragile X syndrome, the most common form of intellectual disability in the general population (Hagerman & Hagerman, 2008). Females carry two X chromosomes, so if they carry one normal FMR1 gene, it negates most of the effects of a defective gene on the other X chromosome. Because so many different mutations occur in the FMR1 gene, the impairment of mental functions also varies widely.



The Cost of Treating Cystic Fibrosis

Each year in the United States about 30,000 babies are born with cystic fibrosis, a disease that causes severe lung and breathing problems. Cystic fibrosis occurs when an affected child inherits a malfunctioning gene from each parent. Modern medical treatments enable babies born with cystic fibrosis to survive to about age 40, but there still is no cure.

In 2012, the FDA and health programs in Canada, the European Union, and other countries approved the drug Kalydeco (ivakator), which can restore lung function in a specific subtype of cystic fibrosis found in about 4 of every 100 patients. Vertex Pharmaceuticals, the company that manufactures Kalydeco, charges \$311,000 for a year's supply of pills (taken twice daily). Most cystic fibrosis patients who respond to the drug will need to take it for decades to stay alive.

Many doctors, patients and their families, and insurers, including the U.S. government, which pays for the drug through Medicare Disability and Medicaid, object to the high cost. They point out that the scientific research that discovered the drug was paid for by taxpayers and that Vertex received considerable help from the nonprofit Cystic Fibrosis Association and hence spent less than the typical \$1 billion to \$2 billion to develop the new drug. The exorbitant cost of this drug is more than most families can afford, so they turn to government medical programs for financial assistance. Hence, taxpayers are supporting the multibillion-dollar profit for Vertex. In the for-profit model of drug development and sale, Vertex is doing nothing illegal to price its product as it sees fit.

The cost of Kalydeco and other new drugs approved for serious diseases—especially cancer, which is almost always more than \$100,000 per treatment or annually if the drug must be given continuously—is a pressing problem facing the healthcare system. With modern genetic technologies to help produce more drugs to treat small numbers of patients, industry and drug developers are tempted to exploit their advantage financially.

Preventing Hereditary Diseases

Genetic Counseling

Genetic counseling is a medical specialty that helps people learn about genetic conditions, find out their chances of being affected by or having a child or other family member with a genetic condition, and make informed decisions about testing and treatment. Among the reasons for seeking genetic counseling are having a family history of a genetic condition (including a genetic condition or birth defect occurring in a previous pregnancy), to learn about genetic screening for diseases that are more common in certain ethnic groups (e.g., sickle cell disease in African Americans and Tay-Sachs disease in Ashkenazi Jews), and other genetics-related concerns. Genetic counseling professionals include *clinical geneticists*, who are doctors with expertise in genetics, and *genetic counselors*, who are professionals trained to provide counseling and support for people and families with genetic conditions. Getting a recommendation from a healthcare provider is the best way to find a genetics professional. Genetic counseling begins with objective calculations of genetic risks to a fetus, which, in some cases, guarantee that an abnormal fetus is being carried. Although genetic counselors strive to be objective, the counseling process is subtle and counselors may inadvertently interject personal opinions. For example, prospective parents who each carry an abnormal gene may be told that they have 1 chance in 4 of having a genetically handicapped child. Or they can be told that the odds are 3 to 1 that they will have a healthy child. Both statements express the same mathematical probabilities, but the prospective parents may well interpret the two statements quite differently. One statement emphasizes a negative outcome, the other a more positive outcome.



Determining If You Are at Risk for Bearing a Child

with Genetic Abnormalities

Prenatal testing and genetic counseling are advised if a person falls into any one of the following risk categories:

- maternal age over 35 years (risk of Down syndrome),
- high or low levels of alpha-fetoprotein during pregnancy (risk of neural tube defect),
- woman had a previous child with a chromosomal abnormality or neural tube defect,
- woman had a previous stillbirth or neonatal death,
- woman or mate carries a previously diagnosed chromosomal or genetic abnormality,
- woman carries a previously diagnosed defective gene,
- woman and mate carry the same previously diagnosed defective gene,
- close relatives have a child with an inherited disorder,
- woman has been exposed to a teratogenic agent during pregnancy, or
- woman has recently been infected by rubella (measles) virus or cytomegalovirus.

A health professional giving advice or making recommendations that affect the life of other persons can involve difficult moral decisions and many conflicting views. Ideally, the personal views of a genetic counselor would not influence the decision-making process of couples or families assessing the choices brought forth in genetic counseling. In the best cases, these couples and families arrive at their own informed decisions after careful consideration of all of the medical facts and risks.

Genetic Testing

Genetic testing encompasses scientific procedures that identify changes in chromosomes, genes, or proteins to confirm or rule out a suspected genetic condition or help determine a person's chance of developing or passing on a genetic disorder. More than 1,000 genetic tests are currently available, and more are being developed. Genetic testing can include (1) identifying single genes or short

lengths of DNA to identify variations or mutations that lead to a genetic disorder, (2) analyzing entire chromosomes or long lengths of DNA to identify changes in chromosome number or shape, and (3) determining the amount or activity level of proteins, which can indicate changes to the DNA that result in a genetic disorder.

Genetic testing is voluntary. Because testing has benefits as well as limitations and risks, the decision about whether to be tested is personal. A geneticist or genetic counselor can help by providing information about the pros and cons of the test and discussing the social and emotional aspects of testing.

Genetic tests are most useful when they are used to prevent passing on genes that cause serious inherited disorders. Some common inherited disorders for which genetic tests are available include cystic fibrosis, sickle cell anemia, hemophilia A, Duchenne muscular dystrophy, Huntington's disease, and fragile X syndrome. People who are concerned whether they or other family members carry an abnormal gene can consult with a genetic counseling professional.



Saving a Life with a Life

Once in awhile seemingly futuristic medical and genetic technologies work as scientists hope envision. Several medical technologies came together for Molly Nash, an extremely sick 6-year-old who had inherited Fanconi's anemia. This is a severe blood disease that usually kills children before age 10 unless a bone marrow transplant is performed successfully. To be successful, the donor's bone marrow cells must be extremely closely matched to the recipient's human leukocyte antigen (HLA) cell type to prevent rejection of the transplanted tissue.

In 2000, Molly Nash's parents were offered a never-before-tried solution to their daughter's fatal condition: Her parents would have another child whose genes would closely match Molly's so a successful transplant would be possible. On August 29, 2000, Adam Nash was born and Molly received her bone marrow transplant and it worked. Here's what happened.

Doctors removed eggs from Molly's mother's ovaries. They were then fertilized in a laboratory dish using sperm from Molly's father and grown for a while in vitro (in glass dishes in the laboratory). When the embryos were ready to be implanted into Molly's

mother's uterus, each one was genetically tested; only an embryo with precisely the right combination of HLA genes would lead to a cure for Molly. An embryo with the matching HLA genes was obtained and successfully implanted. At its birth, the umbilical cord blood was saved and later used in a bone marrow transplant for Molly. The cells in her sibling's blood were so closely matched to Molly's cells they were not rejected. Her new bone marrow cells flourished and Molly's blood disease was cured. Many things had to go just right for this procedure to work, and they did.

In 2010, Molly received her 10-year checkup. She was 16 years old and healthy. So is her 10-year-old brother Adam. Since this pioneering medical success, the procedures have been successfully performed on other children with fatal blood diseases. Today, all the major in vitro fertility (IVF) clinics can genetically test laboratory embryos. Most of the testing is now done to ensure that the implanted embryo does not carry genes that cause serious inherited diseases. But some scientists and others worry that the time may come when parents may want to have embryos tested for genes that confer talents such as athletic or musical ability, eliminate susceptibility for cancer or heart disease, or prolong life. The list is endless, as are speculations about abuses. As the great Yankee baseball catcher Yogi Berra supposedly said, "Prediction is very difficult—especially if it's about the future."

Testing for breast cancer susceptibility genes illustrates some of the complex issues surrounding genetic testing.

The risk of a woman developing breast cancer is strongly influenced by inheriting one or both cancer susceptibility genes called *BRCA1* and *BRCA2*. Inheriting both susceptibility genes means a woman has an 80% to 90% probability of developing breast cancer at some time in her life, usually while in early or middle adulthood. In families whose female members have a high incidence of breast cancer, young women can be tested for the presence of these susceptibility genes. If both genes are found, the individual is faced with two choices. She can worry and wait for signs of breast cancer. Or she can elect to have prophylactic mastectomy in which both breasts are surgically removed while she is young to avoid the development of breast cancer later in life.

Women who carry breast cancer susceptibility genes can choose to have a child using in vitro fertilization. A single cell from the embryo can be tested to make sure it does not carry *BRCA1* or *BRCA2* genes before it is implanted. In this way, parents can be sure the harmful genes will not be passed on to their child.

Prenatal Testing

Prospective parents can be tested for the presence of genetic abnormalities that might be passed on to their children. Also, it is possible to test if a fetus in utero is affected by a genetic abnormality. One such procedure is **amniocentesis** (Figure 12.3). In this procedure, fetal cells are obtained by removing a sample of amniotic fluid from the uterus around the 15th week of pregnancy. Although amniocentesis is safe, there is still a small risk of harming the fetus or inducing a miscarriage. The physician should discuss the risks and benefits of the procedure as part of the genetic counseling. Amniocentesis is performed so that prospective parents can decide whether to continue the pregnancy to term. The decision is generally made after discussion with their physician and a counselor.

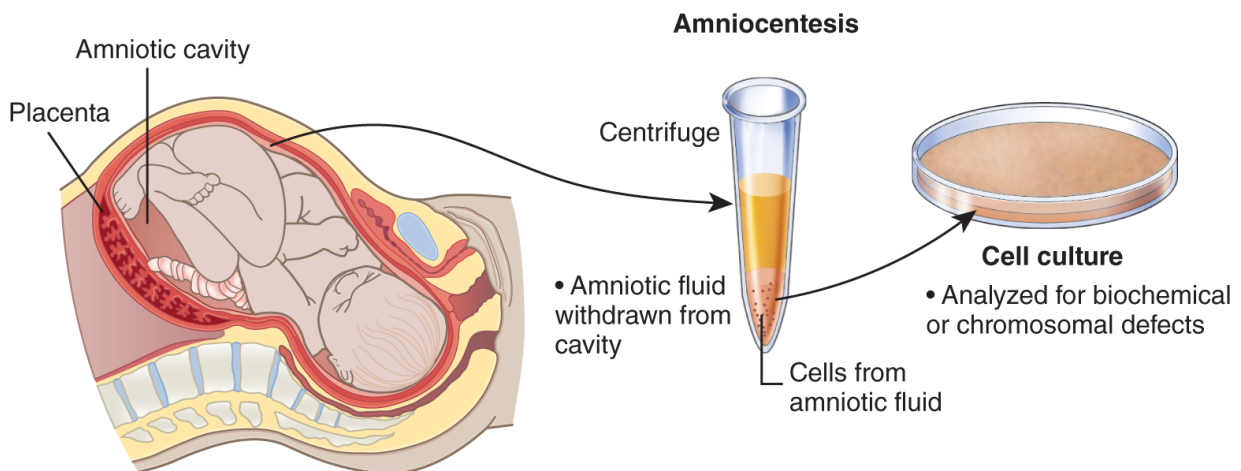


Figure 12.3 Amniocentesis. In the diagnostic procedure called *amniocentesis*, a sample of the fluid that surrounds the developing fetus is collected. Both the fluid and the fetal cells it contains are then analyzed for biochemical or chromosomal defects.

Description

The fetal cells obtained by amniocentesis are grown in a laboratory dish and tested for biochemical and genetic abnormalities. Examination of the chromosomes in the karyotype analysis also identifies the sex of the fetus, but this information is provided only if the pregnant woman specifically requests it. (Although most people

in American society are joyful at the birth of either a boy or a girl, in other countries male children are still considered more desirable. In fact, determination of a female fetus by amniocentesis and karyotype analysis is the most common cause of elective abortion in many countries.)

Another prenatal procedure called **chorionic villus sampling** can be performed as early as 8 weeks after conception. This earlier test provides information regarding the health of the fetus, allowing the parent(s) to make an earlier decision with respect to terminating the pregnancy.

A noninvasive form of prenatal testing is **ultrasound scanning**, which is used to visualize the developing fetus (**Figure 12.4**). Ultrasound scans use high-frequency sound waves that bounce back from the various tissues in the fetus with different intensities. The sound waves reflected from the fetus are displayed on a screen, and the image is interpreted by a physician trained in the use of this technique.



Figure 12.4 Ultrasound Scanning. Image of a fetus obtained by ultrasound scanning. Such ultrasound scans reveal the position of the fetus and may also indicate certain physical abnormalities.

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Ultrasound scans are used to detect multiple fetuses and to determine the location of the placenta, which is important if amniocentesis is to be performed. The scans can gauge the fetus's head size, thereby providing determination of the age of the fetus. Abnormal brain development and neural tube defects also can be diagnosed with an ultrasound scan.

Genetic Discrimination

One of the potential harmful consequences of genetic testing is the possibility of discrimination against a person because he or she

carries a particular genetic makeup—for example, one that predisposes the person to a disease or perhaps a physical trait such as short stature or blue eye color. We all understand what discrimination based on sex or race means, and laws have been passed to prevent racial or sexual discrimination in employment, housing, the armed services, and other public settings. Although rarely described in genetic terms, racial and sexual discrimination are actually a form of genetic discrimination because sex and skin color are determined by the genes that were inherited from parents.

Employers and insurance companies are the organizations most interested in knowing what abnormal genes a person may have inherited. Companies would obviously prefer not to hire someone who is likely to have a serious health problem after working a few years. Such a person is costly to a company because of wasted training, lost work, and the costs of health benefits. A company's health insurance plan might even be canceled if the benefits paid become too high.

It ain't what we don't know that gives us trouble. It's what we know that ain't so that gives us trouble.

—**Will Rogers**, American Comedian and actor.

Health insurance and life insurance companies also would like to have information about a person's genetic profile so that they could select members who are “good” risks and reject those who are “poor” risks. Insurance companies are profit driven, like all companies, and usually can obtain information about genetic tests from a person's medical record. Thus, everyone needs to be cautious in allowing others to have access to their medical records. The Genetic Information Nondiscrimination Act forbids:

- An employer from firing or not hiring a person based on information obtained from genetic testing,

- Insurance companies from denying health or life insurance to persons based on information obtained from genetic tests
- Companies from charging higher premiums for persons with disease susceptibility genes

The advent of commercial genetic testing presents a dilemma regarding genetic privacy. Many genetic analysis companies promise not to divulge a customer's private genetic information without consent. However, various tech companies have proved reluctant not to accede to requests from government agencies or courts for their clients' data. Also, people who share their genetic data online, perhaps in the search for long-lost relatives, give up their rights to genetic privacy.

Thousands of human disorders are caused by inheriting abnormal genes. The goal for medical science is to cure these inherited diseases.

Occasionally, an abnormal protein produced by an abnormal gene can be manufactured in a test tube and injected into patients to replace a missing or abnormal one, as in the treatment for hemophilia. In other cases, drugs are used to lessen the severity of symptoms, as in cystic fibrosis and sickle cell anemia. However, because a fundamental gene is defective in all of the cells in a person's body, these kinds of treatments do not permanently cure the patient. That is the goal of **gene therapy**, an experimental method that uses genes to treat or prevent disease. Researchers are testing several approaches to gene therapy, including (1) replacing a defective gene that causes disease with a healthy copy of the gene; (2) inactivating, silencing, or "knocking out" a gene that is functioning improperly; and (3) introducing a new, different gene into the body to help fight a disease.

Since the elucidation of the complete chemistry of the human genome in 2001 (U.S. National Human Genome Research Institute, 2018), scientific understanding of how genes work, and hence ways to alter malfunctions, has deepened. More and more genes have

been identified and obtained to be used in gene therapy trials involving replacing or silencing malfunctioning genes by a variety of techniques. The hope is that the normal gene will function once it is in the cells and that the protein will be produced in sufficient quantity to cure the inherited disease permanently.



Self-Care: Empty Your Cup

The Learned Professor came to the house of the Zen Master to ask to learn Zen.

“You are very welcome,” said the Master, inviting the Learned Professor in for tea.

They sat on cushions facing each other.

Preparing to make tea, the Master set a pot of water on the charcoal brazier on the floor in front of him, while the Learned Professor told of the many books he had read about Zen.

The water having boiled, the Master made tea while the Learned Professor told of all the insights about Zen he had gleaned from talking to other great scholars.

The tea made, the Learned Professor held up his cup and continued to talk about Zen.

The Master poured tea into the Learned Professor’s cup. And he and poured . . . and poured . . . and poured, until tea was spilling over the top of the cup and cascading onto the floor.

“What are you doing?” cried the Learned Professor. “The cup is full. No more will go in!”

“Your mind is like the cup,” said the Master. “How can you expect to learn unless you first empty your cup?”

What thoughts, beliefs, desires, and avoidances do you hold on to even when they’re past their expiration date? You can find out by asking yourself, “What am I getting from holding on to this?”

As the Zen Master tried to teach the Learned Professor, sometimes letting go of an attachment creates psychic space for new, better things—ideas, time, energy, love, inner peace, awe—to come to you. The stronger the attachment, the harder it is to let go, even when engaging or pursuing the attachment is personally harmful. Three steps to letting go: (1) STOP! when you notice you are craving something you no longer want or need;

(2) let whatever emotions arise without doing anything to stop, avoid, or replace them; and (3) be curious about what might replace them; it could be interesting.

The logic of gene therapy is sound, but in practice it has proved exceptionally difficult to overcome many technical and biological obstacles. In 2000, it appeared that gene therapy had its first major success. Several children in France suffering from a severe inherited immune system disease were given healthy genes, and their immune systems began functioning normally. The normal genes were transferred to their cells using what was thought to be a harmless virus as a vector to carry the genes into cells. Scientists hailed the results. By the end of 2002, however, two of the children had contracted leukemia, presumably from the virus that had been used in the gene therapy experiment. The use of this method of gene therapy was suspended, and scientists began searching for other means of transferring genes to cells.

After decades of setbacks for gene therapy techniques to cure inherited diseases, there are now some significant successes (Lewis, 2014). A few patients with hemophilia, a serious inherited blood disorder, have been helped through insertion of normal genes into their cells. Gene therapies for inherited immune diseases, blindness, and lung disease are in development or have been approved for use. Researchers are looking to develop therapies for Alzheimer disease, diabetes, heart failure, and cancer.

Although gene therapy is a promising treatment option for some diseases (including inherited disorders, some types of cancer, and certain viral infections), the technique remains risky and is still under study to make sure that it will be safe and effective. Gene therapy is currently being tested only for diseases that have no other cures.

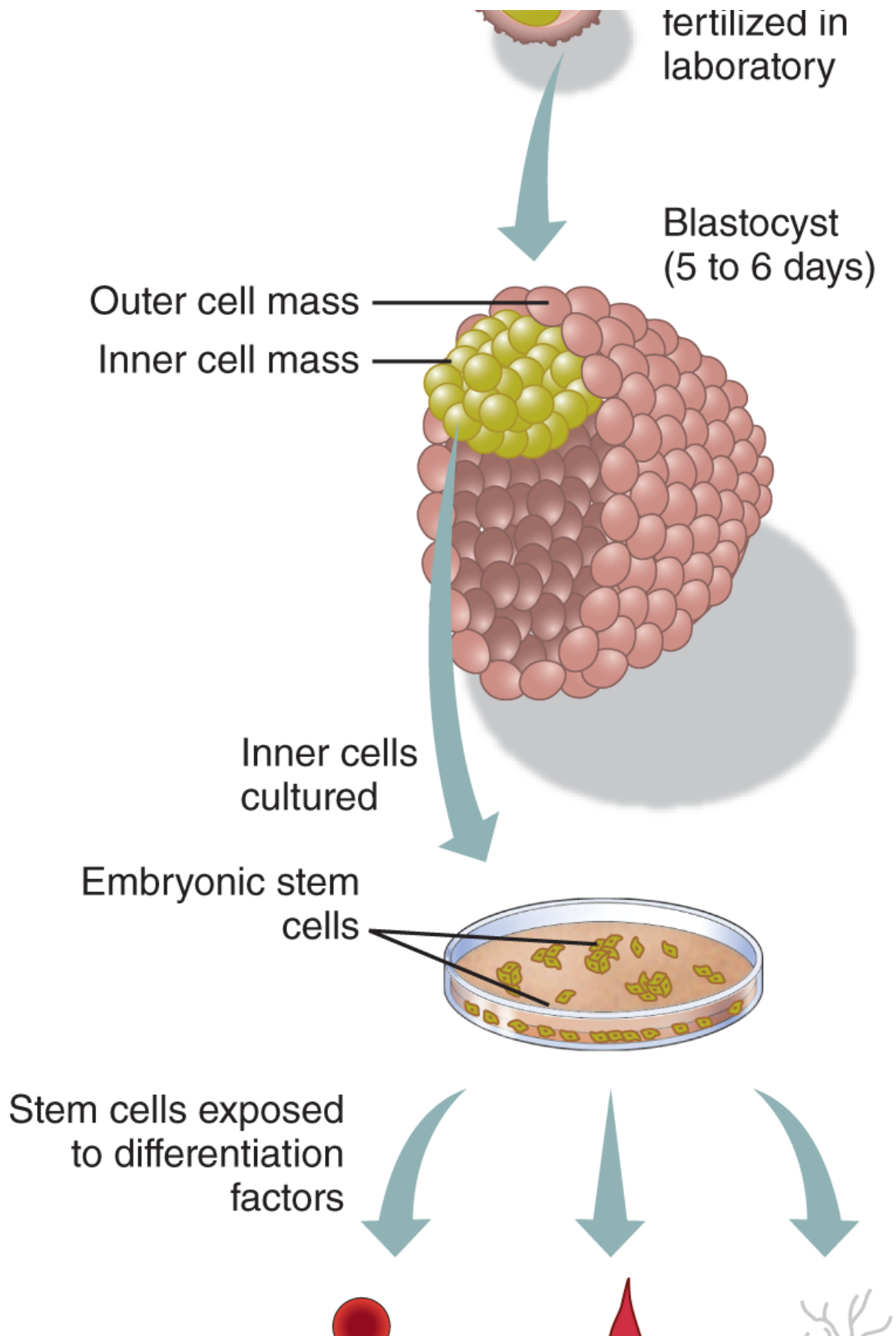
Gene Therapy

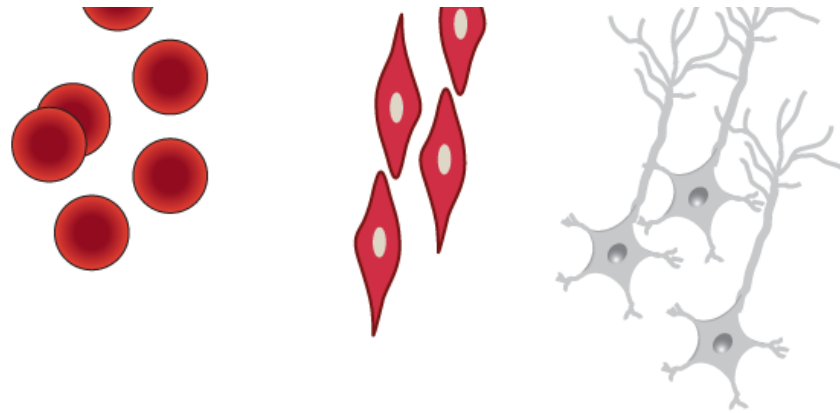
Embryonic Stem Cells

A generation ago there was great consternation and public debate over the ethical and social issues associated with in vitro fertilization. Today, the benefits and risks of IVF are widely accepted, and millions of children, many of whom have reached reproductive age themselves, have been conceived using assisted reproductive technologies. However, the ability to create human embryos in the laboratory has led to research with unused laboratory-derived embryos to generate **embryonic stem cells**. Such cells hold great promise for treating currently incurable diseases such as Parkinson's disease, amyotrophic lateral sclerosis, spinal injuries, and type 1 diabetes.

A human being begins with a fertilized egg that develops over a span of 9 months in the uterus into a fully developed infant. When a human embryo develops to the point where it contains several hundred cells, it is called a *blastocyst* (**Figure 12.5**). The internal cells in the blastocyst are embryonic stem cells because they possess the capability of developing into any body tissue such as lung, heart, liver, brain, and almost all others. In a laboratory, cells can be removed from early-stage embryos and grown in large numbers in laboratory dishes, where some develop into stable embryonic stem cells that can be stored or grown under special conditions during which they develop into specialized cells and tissues. Stem cells retain the potential for developing into specific tissues almost indefinitely. When injected into organs in the body, stem cells can replace specialized tissues that may have been damaged or destroyed by disease.







Blood cells Muscle cells Neural cells

Figure 12.5 Isolation of Embryonic Stem Cells. A fertilized egg is allowed to develop in the laboratory until it contains several hundred cells. Some of these cells are spread on laboratory dishes where they grow into colonies of embryonic stem cells. These cells can be grown almost indefinitely; when they are exposed to certain environments, they differentiate into cells characteristic of specific tissues and organs.

Description

For example, mouse embryonic stem cells that have been injected into the pancreas of diabetic mice can develop into pancreatic cells capable of producing insulin. The research with mice suggests that some forms of human diabetes (type 1) might be helped by the use of human embryonic stem cells.

A major goal of stem cell research is to develop stem cells that contain an individual's own genetic information. This can be accomplished as follows. Cells are removed from a patient with a serious disease. Several nuclei are removed and injected into human eggs from which the nuclei have been carefully removed (enucleated eggs). Each egg with the patient's cell's nuclei will develop into a blastocyst in a laboratory dish. Then single cells are removed and grown into stable embryonic stem cells. If this is successful, the individualized stem cells can be used to treat the patient's disease without concern about rejection because the genetic information in the stem cells is the same as in the patient's own cells.

Embryonic stem cell research is exceptionally controversial in the United States. Supporters of such research point to its enormous potential for relieving human suffering and treating incurable diseases. Opponents believe that every human embryo, regardless of how it was created, is a potential “person” and that the “soul” enters when fertilization takes place or when an embryo exists. Despite ethical concerns and scientific setbacks regarding stem cells derived from embryos, stem cell therapies that do not depend on embryonic tissues are being developed and used to treat serious diseases.

Genome Editing

The *genome* is the entirety of all the DNA in an organism’s cells. The composition of a human’s genome is established at conception and remains unchanged for life, although small parts of a genome can change, depending on interactions with the environment. For example, sunlight (ultraviolet radiation) acting on skin cells can alter their DNA, causing some of them to become redder or darker or even cancerous.

In 2015, scientists discovered a way to change precisely, easily, and inexpensively the composition of a person’s DNA using a method of **genome editing** called *CRISPR/Cas-9* and also referred to as *gene editing* or *gene splicing*. This method allows segments of DNA to be changed, added, removed, or distributed to different locations within cells. For example, if ultraviolet radiation in sunlight has damaged some part of the DNA in a person’s skin cells, genome editing could be employed to snip out the affected DNA and replace it with an undamaged copy of the original or a piece of DNA customized in some other way. Genome editing using CRISPR/Cas-9 is being explored in research on a wide variety of diseases, including single-gene disorders such as cystic fibrosis, hemophilia, and sickle cell disease. The method may also be instrumental in treating and preventing more complex conditions such as some types of heart disease, mental illness, and infections.

Ethical concerns arise when genome editing is used to alter the genomes in eggs and sperm or the DNA of embryos. Such changes would be passed from one generation to the next. This would be beneficial to any potential parent who carried a harmful gene such as Huntington's disease or hemophilia. However, the technology could be used to control normal human traits such as height, musical ability, or intelligence. This is why sperm, egg, and embryo genome editing are currently illegal in many countries.

Critical Thinking About Health

1. A friend who is about 25 years old has just learned that she is pregnant. The woman smokes cigarettes and likes to party on weekends. Based on what you have learned about the causes of congenital defects in this chapter, make a list of all the behavioral, dietary, and lifestyle changes you would recommend to your friend to help ensure that she gives birth to a healthy child. Discuss the rationale for each of your recommendations.
2. Are scientists morally obligated to inform nonscientists of results of their research that might bear on susceptibility to a serious disease? Here is an example.

A scientist is studying the DNA from patients who have died from cancer of the pancreas. She is trying to discover any genes that may be involved in the development of the disease. She finds that the DNA of many patients with pancreatic cancer carry mutations that are known to cause other cancers. One such mutation is *BRCA2*, which is a well-established risk factor for breast and ovarian cancer in women. Should the scientist inform relatives of pancreatic cancer patients of her discovery so they can be tested for *BRCA2*? Even though most cancer susceptibility genes increase risk, they do not make cancer inevitable. If you agree they should be informed, how should relatives be notified and what support should be offered? On the other hand, should relatives not be told because there is no certainty they will develop pancreatic cancer and there is no established rule or law that says relatives should be informed of harmful mutations found in a relative's DNA?

3. A few years ago, the U.S. military ordered all service personnel to have a blood sample taken so that the DNA of each individual's cells could be analyzed and the pattern placed on file, much as the FBI keeps files of fingerprints of criminals and others. The reason the military wants each service member's DNA analyzed is so that

remains can be positively identified in case that person dies in a military conflict. One soldier refused to give a blood sample in violation of a direct order and was ordered to stand before a court martial. The soldier argued that he had no assurance that his DNA information would be kept private and would not be used for purposes of discrimination or to his detriment in other ways.

Do you think the military is justified in wanting each person's DNA on file?

In what ways might the DNA information be used to the detriment of the soldier either in the military or after his release from military service?

Discuss the pros and cons of having the DNA profile of every person in the United States on file in a federal agency so that any person could be positively identified by law enforcement authorities, government agencies, or other organizations.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

The hereditary information in every human being is contained in long, chainlike molecules of DNA. The molecules of DNA, in turn, are packaged into 46 chromosomes, 23 of which come from each parent. All of the information needed to construct a human being is contained in about 3 billion pairs of four different chemical letters: A, G, C, and T. Every human trait from skin color to the propensity for athletic and intellectual ability is contained in this massive “Book of Life.” In the 1990s, scientists decided to decipher the exact sequence of the 3 billion elements in one person’s DNA. The U.S. government funded the idea and established the Human Genome Project. The goal of sequencing a complete human genome was reached in 2003, when the entire sequence was published online. The cost of this project was \$2.7 billion. In the years following this amazing accomplishment, the complete DNA sequences of some viruses, bacteria, yeast, plants, and animals were obtained. This became possible because the cost of sequencing DNA dropped dramatically as the process became automated and computerized. Today, the cost of sequencing all of the DNA in a person is only a few thousand dollars.

Because of these advances in sequencing DNA, a revolution has occurred in our understanding of inherited (genetic) diseases. A defect in a single gene can cause a genetic disease such as sickle cell anemia, muscular dystrophy, cystic fibrosis, hemophilia, and thousands of others. Genetic defects can be identified in prospective parents, and new genetic and reproductive technologies help prevent the defective genes from being passed on to children. Diseases such as cancer, heart disease, diabetes, and other chronic conditions are caused not by a single gene but by many genes that together increase a person’s risk. Companies can sequence your DNA and inform you of your risk for hundreds of diseases . . . if you

want to know. Scientists can now reconstruct human history and population migrations by analyzing the DNA of modern people. You might be interested to know that everyone carries a few genes from our Neanderthal ancestors. Personalized medicine is a new medical specialty based on analyzing patients' DNA and tailoring treatments to their specific genes. Cancer patients receive drugs that are most likely to destroy their particular tumors. Personalized medicine means that most treatments in the future will be customized to the patient's particular set of genes. The genetic revolution is likely to generate even more spectacular results than the Internet and communication revolution of the recent past.

HIGHLIGHTS

- Every newborn inherits 23 chromosomes and about 20,000 genes from each parent. Inheriting abnormal chromosomes or abnormal genes can result in an inherited disease.
- Genetic information is carried in DNA.
- Congenital birth anomalies are observed in about 1 of 50 newborn babies in the United States. Abnormal development of the fetus during pregnancy can be caused by environmental factors, abnormal genes that were passed on from one or both parents, or a combination of both.
- Ultrasound, amniocentesis, and chorionic villus sampling are prenatal diagnostic procedures that can determine whether fetal development is normal or whether there is a physical or biological defect.
- Taking prescription or illegal drugs, drinking alcohol, or becoming infected by viruses during pregnancy also can harm the fetus. If drugs or alcohol are used by a pregnant woman,

especially in early pregnancy, the fetus may abort spontaneously or the newborn may suffer growth deficiencies, intellectual disabilities, or other problems.

- Couples who are at higher-than-average risk for having a child with a genetic abnormality should undergo genetic counseling before and after pregnancy is established.
- Modern genetic diagnostic tests can detect genes responsible for hundreds of hereditary diseases; however, only a few can be treated successfully.
- Genetic discrimination may occur when people find out that they or others carry genes that predispose them to diseases and disorders. A federal law prohibits genetic discrimination.
- Gene therapy is a promising new method of treating genetic diseases.
- Embryonic stem cells are derived from early-stage embryos produced in the laboratory. Such cells have the potential to differentiate into any desired tissues. Such cells may help cure serious diseases.
- Genome editing, also referred to as *gene editing* or *gene splicing*, allows segments of DNA to be changed, added, removed, or distributed to different locations within cells.

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KEY TERMS

genetics:

refers to biological entities responsible for the transmission of hereditary traits

genes:

biological entities responsible for the transmission and proper functioning of cells

chromosomes:

threadlike structures in the nuclei of cells that carry an individual's genetic information

deoxyribonucleic acid (DNA):

the chemical substance that carries all of a person's genetic information in chromosomes in cells

proteins:

complex biological chemicals, each with an important role in the structure, function, and regulation of the body's tissues and organs

karyotype:

visual display of all of a person's chromosomes that can detect chromosomal abnormalities characteristic of inherited diseases

lactose intolerance:

the biological inability to digest the milk sugar lactose

congenital (birth) defect:

any abnormality observed in a newborn that occurred during development

teratogen:

any environmental agent or drug that alters development of a fetus

fetal alcohol syndrome (FAS):

birth defects and mental disabilities caused by ingestion of alcohol by the mother during pregnancy

hereditary (genetic) disease:

any disease resulting from the inheritance of defective genes or chromosomes from one or both parents

newborn screening:

testing newborns for the presence of abnormal genes

genetic counseling:

information to help prospective parents evaluate the risks of having or delivering a child with a genetic abnormality

genetic testing:

medically supervised procedures that identify changes in chromosomes, genes, or proteins to confirm or rule out a suspected genetic condition or help determine a person's chance of developing or passing on to children a genetic disorder

amniocentesis:

a procedure in which amniotic fluid is removed from the uterus and tested to determine whether genetic or anatomical defects exist in the fetus

chorionic villus sampling:

a prenatal procedure used to determine whether genetic or anatomical defects exist in a fetus; an alternative to amniocentesis

ultrasound scanning:

use of sound waves to visualize the fetus in the uterus

gene therapy:

a technique for replacing defective genes with normal ones in certain tissues of a person affected with a hereditary disease

embryonic stem cells:

cells derived from human fertilized eggs and grown in laboratory dishes; stem cells have the capacity to differentiate into many different tissues and organs

genome editing:

a method to precisely add, change, or remove segments of DNA



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CHAPTER 13

Using Drugs and Medications Responsibly



Health Tips

Don't Overdose on Over-the-Counter Painkillers

Screen Addiction to Video Games, the Internet, TV Binge-Watching, and Smartphones



Dollars & Health Sense

The Opioid Tragedy and Deaths of Despair



Wellness Guide

Self-Care: The Power Write

LEARNING OBJECTIVES

1. Explain the difference between a drug and a medicine.
2. Explain the concept of a drug receptor and its relation to drug side effects.
3. Describe the logic of a double-blind drug effectiveness study.
4. Give examples of the overuse of legal drugs in American society and the influences of drug advertising on drug use.
5. Explain the FDA's drug approval process.
6. Define addiction, physical dependence, habituation, tolerance, and withdrawal.
7. Describe the different effects of the major classes of psychoactive drugs: stimulants, depressants, marijuana, hallucinogens, PCP, and inhalants.
8. Describe the health hazards of using anabolic steroids.

A **drug** is a single chemical substance that alters the structure and function of one or more of the body's biological processes. Depending on the specific chemical, the alteration can be to start, stop, speed up, or slow down a biological process. Modern drugs are obtained from plant and animal material and microorganisms, or they are manufactured from basic industrial chemicals or living cells. For example, monoclonal antibodies, recognized in mass advertising by the suffix *-mab*, are manufactured in animal cells for treating infectious diseases. RNA vaccines, like those used to protect against COVID-19, are manufactured from a specific part of the COVID-19

virus, packaged in a bubble of fat molecules. The opiate drug heroin is obtained by chemically modifying opium obtained from the poppy plant; the opiate fentanyl is manufactured from industrial chemicals.

Too much of a good thing is wonderful.

—**Mae West**, noted American actress, singer, and playwright

A **medicine** is a drug or combination of drugs that is specifically intended to (1) prevent illness, as vaccines do; (2) cure disease, as antibiotics do; or (3) aid healing, as some anticancer medications do. Not all drugs are medicines—for example, alcohol and nicotine. Medicines are usually classified according to the particular biological process they affect rather than by their chemical properties. For example, all substances that increase urine production, regardless of their chemical identity, are diuretics, those that reduce pain are analgesics, and those that activate the nervous system are stimulants.

In 2020, all the world's humans consumed about 4.5 trillion doses of medicines; more than 50% of those people consumed more than one dose per day (IMS Institute for Healthcare Informatics, 2015). The effectiveness of a particular dose of a drug varies, depending on a person's body size, how rapidly the body breaks down and eliminates the drug, and sometimes by the presence of other drugs and foods recently consumed. A drug's effectiveness also depends on a person's expectations of its power, for example, the placebo effect (see Chapter 2), and the person's mental state. For example, when stressed or anxious, many people require higher doses of pain relievers than when they are relaxed. Most drugs have a range of effectiveness—that is, the amounts that produce intended effects. Generally, doses that exceed the range of effectiveness are toxic, and some are lethal. Doses below the range of effectiveness may not work at all.

Just as variations in specific genes can produce different eye color, variations in other genes can determine how the body responds to a particular drug. This is the reason one person may tolerate and respond well to a particular dose of a drug while another person may respond weakly, have an adverse reaction, or even die. The science of **pharmacogenetics** is dedicated to uncovering which genes affect a person's response to a particular drug and using that information to tailor drug therapy to a patient's specific biology to produce optimum benefit with minimal risk. For example, genetic tests enable doctors to match the appropriate dose of the anti-blood-clotting drug warfarin to a patient's corresponding genetic profile (Dean, 2018).



Don't Overdose on Over-the-Counter PainKillers

People take pain-relieving drugs for headaches, backaches, arthritis, joint pain, and many other conditions. Because pain-relieving drugs such as acetaminophen (Tylenol) and ibuprofen (Advil, Motrin) are sold in stores, most people assume they are safe and that you can take as much as you need until you get relief. Those assumptions are incorrect. Acetaminophen, ibuprofen, and many other store-bought drugs can be as dangerous as their prescription counterparts (although not addictive) if not taken as directed on the package and with caution.

Acetaminophen is the most commonly reported cause of poisoning in the United States. Taking more than 4,000 milligrams a day can cause liver failure. Indeed, acetaminophen poisoning is the most frequent reason for liver transplantation in the United States. Because of the dangers of acetaminophen overdose, the U.S. Food and Drug Administration (FDA) asks manufacturers to limit the amount of the drug to 325 milligrams per tablet. Although beneficial to consumers, this request ignores the fact that acetaminophen is sold not only as tablets but also as liquids, suppositories, and chewables and that it also is a component of cold remedies, allergy medicine, and opioid pain medications. If a person takes several acetaminophen-containing medications, overdose is quite possible.

Many people take both acetaminophen and ibuprofen to relieve pain or they take more than the recommend dose. Taking both of these drugs simultaneously increases the risk of an overdose.

People should read carefully all of the ingredients in OTC medications before taking them. Consult a healthcare professional to determine what dose and combination of drugs are safe. If you think you have symptoms of an acetaminophen overdose such as

sweating, nausea, vomiting, diarrhea, or jaundice, you need help immediately. Often the fastest way to get help for any drug overdose or poisoning is to call 911 or get to a hospital emergency room.

As described in Chapter 2, the scientific procedure for establishing the effectiveness of a drug is a double-blind, placebo-controlled trial. This involves a test in which a drug and a taste-and-look-alike placebo (“sugar pill”) are administered to matched groups of volunteers. Neither the researchers administering the drug and placebo nor the individuals receiving them know who is getting the drug or placebo. In other words, both the researchers and the people in the study are “blind” to the details of the procedure. Only when the trial is over is it revealed to the study administrator which volunteers received the drug and which the placebo. For a drug to be acceptable for general use, regulatory agencies like the U.S. FDA rely on the results of the double-blind trial to determine if the drug is sufficiently effective versus the placebo. What is remarkable about many drug effectiveness studies is not that the drug being tested shows a therapeutic effect but that a placebo can sometimes be almost as effective as the drug (**Figure 13.1**).

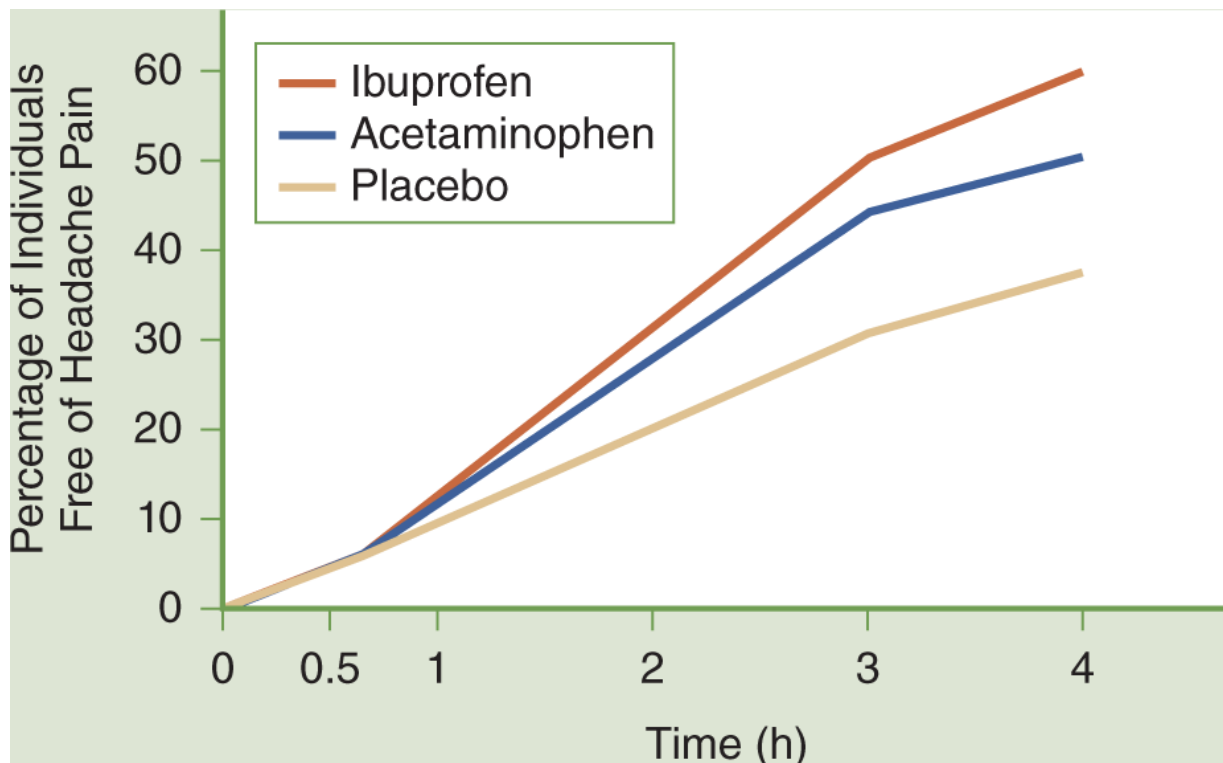


Figure 13.1 A Study of the Effectiveness of Ibuprofen Versus Acetaminophen in Relieving Headaches. Note that almost 40% of headache sufferers get relief from a placebo and no medicine.

Schachtel, B. P., et al. (1996). Nonprescription ibuprofen and acetaminophen in the treatment of tension-type headache. *Journal of Clinical Pharmacology*, 36, 1120–5.

Description

Each year, Americans use about 4.5 billion prescriptions and Canadians about 750 million. About 45% of American adults aged 20–59 use a prescription medicine each month; 48% of people over age 65 use five or more prescriptions per month. This occurs because older people tend to have several chronic medical conditions, each requiring a different medication. It is not uncommon for some older people to take 10 or more different medications daily, which may have been prescribed by different physicians at different times. Occasionally, these drugs interact with each other to cause additional problems. This is why it is important for older people and their families and caregivers to keep a list of all medications and their

doses, and to inquire of health providers about possible drug interactions.

For safety reasons, expired or unused medications and any store-bought products should be disposed of according to FDA guidelines (<https://www.fda.gov/drugs/safe-disposal-medicines/disposal-unused-medicines-what-you-should-know>).

In addition to prescription medications, about 100,000 different kinds of nonprescription or **over-the-counter (OTC) drugs** are purchased by North Americans each year. Furthermore, millions of people use herbal extracts and teas as medicines, and millions more take vitamins, not as nutritional supplements but to prevent or cure disease. Of all these substances, only prescription medications are tested for safety and efficacy.

Drug Laws

In the United States, laws regulate the distribution and use of drugs and medicines. These laws are intended to protect people from any harmful effects from using drugs and medicines. Drug laws fall into five categories:

1. *Prescription drugs*. These chemicals are presumably so potent and possibly dangerous that only doctors can prescribe their use and limit any harm that might ensue.
2. *Over-the-counter drugs*. These chemicals are not so potent or potentially dangerous that consumers can obtain them directly from stores or other sellers without a doctor's prescription.
3. *Dietary supplements*. These chemicals, plant extracts, and vitamins can be obtained by consumers directly from stores or other sellers; they are classified as foods even though biologically they are drugs.
4. *Tobacco (nicotine) and alcohol*. These are potent, addictive drugs with no therapeutic value and are used by choice for a variety of reasons.
5. *Illicit and illegal drugs*. These chemicals are not used therapeutically and are considered so dangerous to users and society that their use is outlawed.

It is wise not to think of legal drugs as good and illegal ones as harmful and bad. Regardless of its medical or legal status, no drug is entirely safe. Any substance that can alter physiology has the potential to be harmful. In many instances, drugs are classified as illegal for social and political reasons and not necessarily because of health concerns. Consumers benefit if they are cautious about taking any drug regardless of its classification in the list just presented.

How Drugs Work

Most drugs act by binding to highly specific chemical regions on the surface of or within cells in the body. These regions are called **receptors**. A drug–receptor interaction is akin to a key (the drug) fitting into a lock (the receptor) (**Figure 13.2**). When drug molecules bind to a cell's receptors, they alter one or more of the cell's biological processes. Frequently, a drug may chemically resemble a natural body chemical, such as a hormone or a neurotransmitter, that interacts with the receptor as part of normal physiological functioning. The drug binds to the receptor in place of the natural substance and thereby alters physiology.

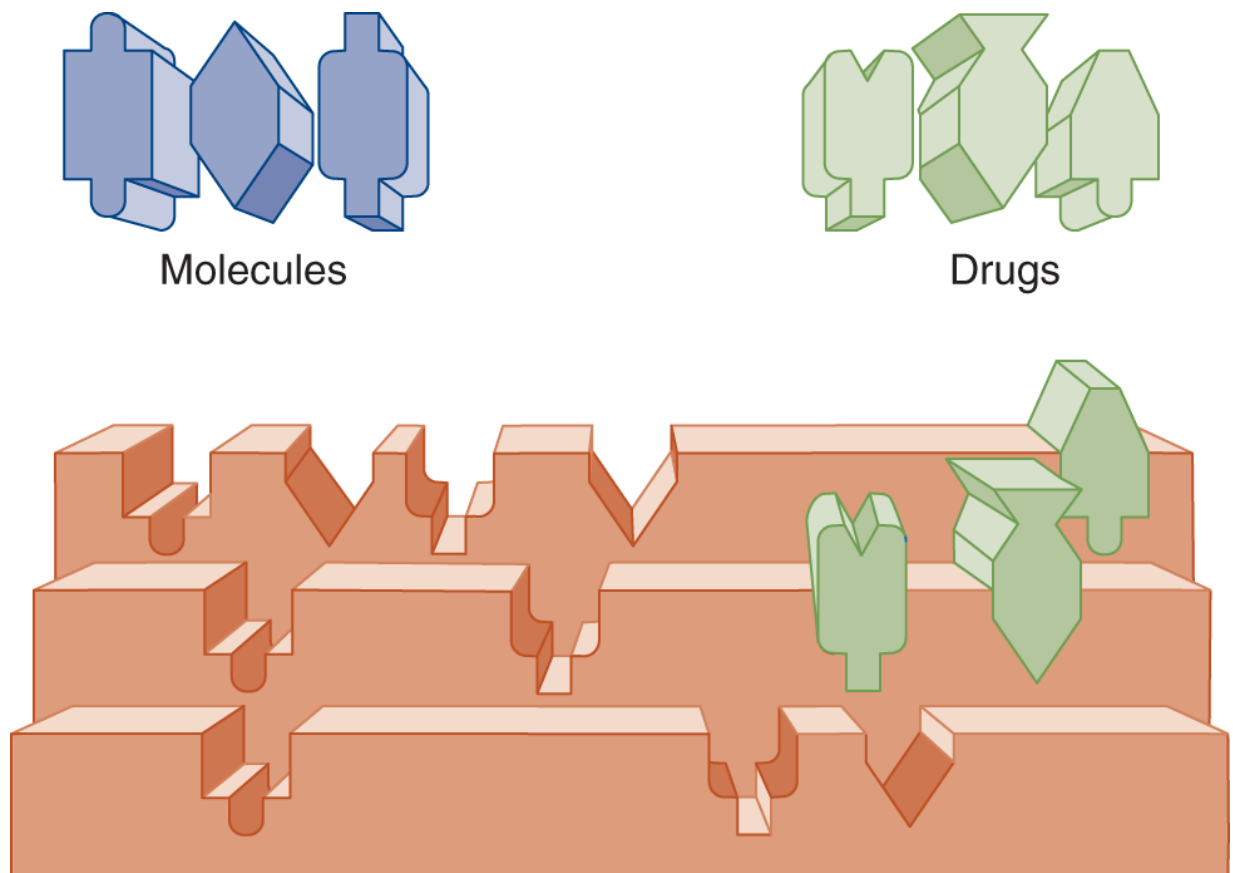


Figure 13.2 Bindings of Drugs to Cellular Receptor Sites. The molecular structures of many drugs are similar to molecules normally produced in the body. The drugs attach to

receptor sites on cells and alter the physiological functioning of organs and tissues.

Description

For example, the receptors for many antidepressant drugs are located on brain cells that utilize the neurotransmitter serotonin. When an antidepressant drug binds to its receptor, serotonin transport into those brain cells is blocked, and often depression is relieved. The anti-breast-cancer drug Herceptin (a monoclonal antibody) binds to a receptor in breast tissue to stop cancerous growth.

Even though a drug or medicine may be intended to have a single effect, often it has more than one because it binds to a variety of receptors in or on different cells, causing **side effects** that may be minor or severe (**Figure 13.3**). Some side effects include allergic reactions (**drug hypersensitivity**), harm to developing embryos and fetuses (**teratogens**), or physical dependence (*addiction*). A drug may also be harmful if the drug taker has a condition that is aggravated by that drug. A medical reason for not taking a drug is called a **contraindication**.

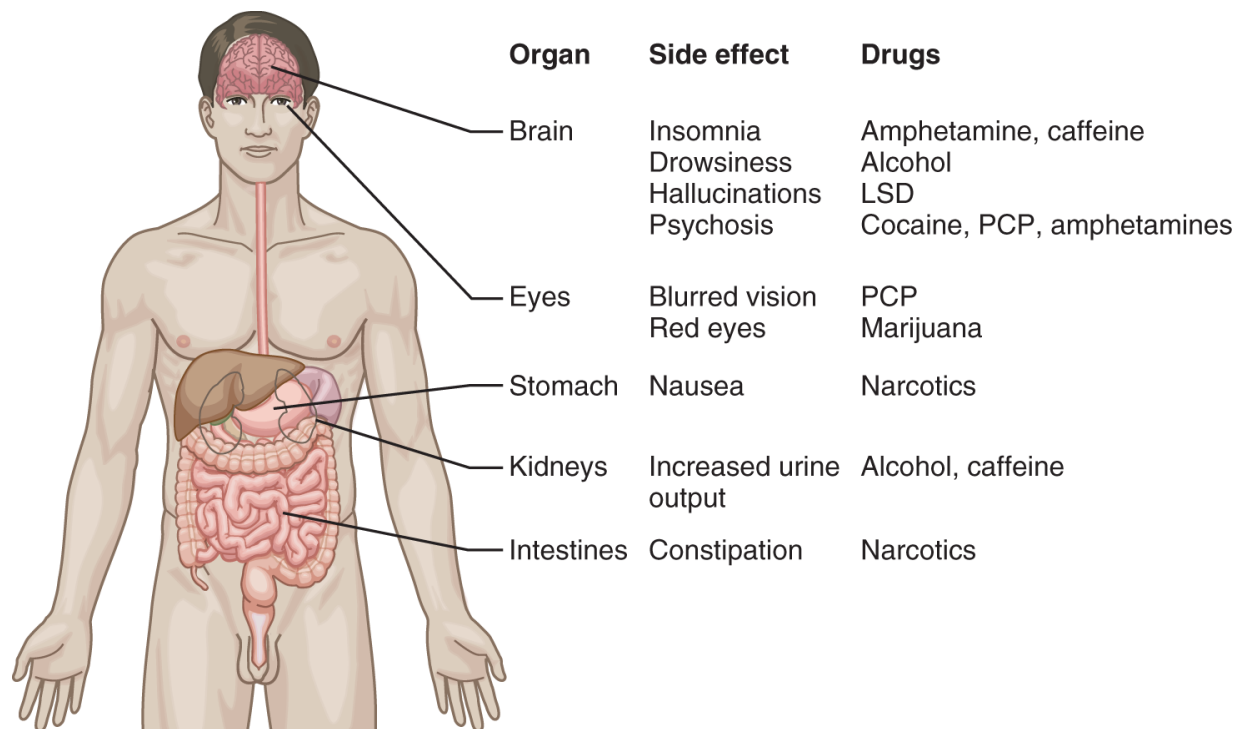


Figure 13.3 Common Side Effects of Drugs of Abuse. The functions of almost every organ or system in the body can be unintentionally altered by the effects of a drug.

Description

Side effects are examples of **adverse drug reactions (ADRs)**. These are unintended, unpleasant, or harmful reactions to medicinal products resulting from (1) errors in prescribing or administering a medicine, (2) a patient’s misuse or abuse of a drug, (3) using a medicine for a medically unapproved reason, (4) unwanted effects associated with cumulative drug exposure, (5) withdrawal reactions (see more in the section on withdrawal), and (6) biological factors that increase susceptibility to a drug’s effects (Coleman & Pontefract, 2016). Between 5% and 10% of patients experience ADRs, which can occur in both hospital and outpatient settings. Elderly persons tend to experience higher rates of ADRs because they tend to take several medicines for long-term illnesses.

The **rebound effect** is the reemergence of symptoms for which a drug is administered after the drug has suddenly been stopped or the dose lessened. These rebound symptoms can often be more severe than the original. When the rebound symptoms occur, doctors and patients can be lured into restarting the drug at high doses. This, however, can lead to further rebounds when the drug is discontinued. The alternative is to taper reduction of the drug to allow the body to adjust to lower doses.

Because almost every drug and medicine has side effects and contraindications associated with its use, consumers are encouraged to research all of the effects of drugs they take and ask their health providers to explain in common language the rationale for the medications that they prescribe (see **Table 13.1**).

TABLE 13.1 Latin Terms Commonly Used in Prescriptions		
Latin	Abbreviation	Meaning

Latin	Abbreviation	Meaning
ante cibum	ac	before meals
bis in die	bid	twice a day
Gutta	gt	drop
hora somni	hs	at bedtime
oculus dexter	od	right eye
oculus sinister	os	left eye
per os	po	by mouth
post cibum	pc	after meals
pro re nata	prn	as needed
quaque 3 hora	q 3 h	every 3 hours
quaque die	qd	every day
quater in die	qid	four times a day
ter in die	tid	three times a day
†, ††, or †††		1, 2, or 3 (of the dosage form, such as tablets)

Drug Development and Cost

Each year about 40 new drugs become available for use. Some new drugs combat new diseases, some replace older drugs because they are more effective, and some may not be needed therapeutically but have attributes that make them attractive to consumers—for example, combining one or more drugs into one tablet or capsule.

Most often, a new drug originates as a discovery made by a researcher. Sometimes the discovery of a potential drug is an accident, like the discovery of the antibiotic penicillin or the blood thinner warfarin. Other times, drug discovery is carefully planned, like the anticancer drug Herceptin. Often new drugs are discovered by scientists at research universities or medical schools. Financial support of the research comes from tax dollars in the form of government grants, like those administered by the U.S. National Institutes of Health and the National Science Foundation. Research grants also are awarded by charitable foundations and disease-specific organizations such as the American Heart Association and the American Cancer Society. Occasionally, drug discoveries are made by drug company researchers or academic scientists who receive financial support from a drug company to carry out specific research. Drug discoveries almost always involve multiple experiments to figure out how to obtain pure quantities of the potential drug and multiple laboratory tests of its effects.

Because drugs are consumer products, their discovery offers their discoverers the potential for financial gain. To protect ownership of a potential money-making drug, discoverers can gain exclusive ownership rights by means of a *patent* issued by a governmental patent authority. Generally, patents for drugs are recognized in other countries, although sometimes not, and a drug discovery is copied. In the United States and Canada, patents on new drugs are in force for 20 years after the application date.

Drug Testing

Once a potential new drug is discovered and patented, to be approved for distribution it must first pass separate tests trials on human volunteers, almost always **double-blind, placebo-controlled trials**. The testing is overseen by a governmental body, such as the FDA. The FDA approval process has three phases:

Phase 1 trial: To determine its safety, the test drug is given in different doses to 50–100 healthy volunteers.

Phase 2 trial: To determine its effectiveness, the test drug is given to several hundred people with the disease or condition for which the test drug is intended.

Phase 3 trial: To determine its overall safety and effectiveness, the test drug is given to 3,000 to 5,000 people with the disease or condition.

If the test drug passes all three phases, the FDA can approve manufacturing and sale of the new drug. Only a small minority of tested drugs are ever approved.

After a new drug is approved and made available to consumers, its safety and efficacy are supposed to be monitored (so-called postmarket evaluation) because unknown problems with a new drug can arise once it's in widespread use. The preapproval testing on a few thousand people is sufficient to uncover obvious problems, but some drugs cause serious problems only in a small percentage of users, and these problems are not evident until many thousands or millions of people take the drug. If postapproval experience shows that a drug is dangerous, the FDA can require that the drug carry a warning called a *black box label* or revoke approval so the drug can no longer be sold. In recent years, several thousand approved drugs have been removed from distribution because of safety concerns. Given that serious health problems caused by a new drug may not appear until the drug has been prescribed for millions of people, the Public Citizens Research Group suggests that all consumers adopt this rule: Do not use any new drug that has been available for less than 5 years if any older and effective drug is available.



SELF-CARE: The Power Write

Sometimes in life, especially when we're stuck, undecided, angry, stressed, and troubled, we get so caught up in our emotions that we lose perspective on what's going on. This is where writing down thoughts and feelings can help. Doing so can help clarify the reasons you feel a certain way and how your thoughts, perceptions, and reactions to situations are affecting your life. Confusing or painful thoughts and emotions are brought into conscious awareness so they can be sorted out, understood, and, if desired, put into the past. Writing forces you to look at your life honestly. Also, writing lets you express yourself privately without concern about someone else's reaction. Research has shown that writing about one's experiences can lessen stress, improve immune functioning, and foster health and well-being.

Writing for clarity and health is a skill you develop with practice, which, in this case, is making regular entries in a journal. *Journaling* is similar to keeping a diary except you express thoughts and feelings instead of record daily events.

- Use a special notebook and perhaps a special writing implement or key into your computer or phone. The notebook can be a bound (and lockable) or loose-leaf paper and binder so entries can be removed, replaced, or copied. A phone or computer should be locked.
- Write in a quiet place with few or no distractions.
- Keep your journal private so you can be honest with yourself.
- Write continuously. Don't worry about grammar or spelling.
- Be expressive. Don't worry about making sense.

The standard procedure for testing a new drug can take 2 years or more. If a new drug shows promise while in testing and there are no alternative drugs, the FDA can grant an accelerated, conditional *fast-track approval*. Fast-track approval requires that full testing continue and removal of the new drug from use if unknown problems are uncovered. It should be noted that fast-track drugs can be offered without special instructions, leaving patients and even doctors unaware that the drug has not been fully tested. After fast-track came into being in 1997, dozens of fast-track drugs have been withdrawn from circulation because they caused serious complications, and in some cases, death.

Drug Costs in the United States

The testing and approval of a new drug is an expensive process—and if the testing is successful, the manufacture and distribution of the new drug is even more expensive. Thus, at some point in the discovery and approval process, ownership of a new drug is sold or otherwise shared with a large, wealthy pharmaceutical company. Of the more than 3,000 pharmaceutical companies in the world, the United States is home to about 200. This group controls about 45% of the worldwide drug market, far exceeding second-place China at 8.5%. Whereas the testing phases of a new drug are extremely expensive to carry out, and the risk of failure for tested drugs is high, the U.S. pharmaceutical industry is one of the most profitable in the world, with more than 18% of revenue as profit. This degree of profitability helps explain why American consumers pay more for prescription drugs than do citizens in peer countries ([Table 13.2](#)). Some major reasons for this include the following.

TABLE 13.2 Cost Per Dose Comparison in US dollars of Prescription Drugs, 2019

Drug	Cost (\$)			
	United States	Canada	India	United Kingdom, Australia
Celebrex (200 mg)	13.72	1.91	1.05	0
Paxil (20 mg)	6.83	2.98	0.98	0
Nexium (40 mg)	7.78	3.37	0.35	2.21
Viagra (100 mg)	58.72	10.77	4.44	8.31
Nasonex (50 mcg)	648.00	50.00	113.92	

Data from U.S. Drug Prices vs. the World (2019). DrugWatch. <https://www.drugwatch.com/featured/us-drug-prices-higher-vs-world/>

Description

1. Prescription drugs and medicines are not like other consumer products. They are required for health and survival, not status or

fun. People feel compelled to have them no matter the cost when their health or life or someone they care about is on the line. No one expects someone to remain horribly sick or possibly die because they cannot afford needed medicine.

2. Patent protection offers pharmaceutical companies a 20-year monopoly on a drug or medicine. During that time period, drug companies can charge as much money for new drugs as they can get away with. And they do! It is not uncommon for some drugs to cost more than \$100,000 a year. Every economically advanced country in the world except the United States negotiates with pharmaceutical companies the prices of drugs for its citizens, which restrains the prices for drugs.
3. The U.S. Congress allows pharmaceutical companies to maintain their monopolies in various ways—for example, by changing the color or dose of a pill to extend a patent.
4. The manufacture and distribution of generics—chemical copies of patented drugs after patent protection expires—is limited. Former patent owners may refuse to give generic manufacturers production details for a drug. They may pay a generic drug company not to make and distribute a drug. They may buy a generic drug company and disallow manufacture of a formerly patent-protected drug.
5. Since 1997, U.S. pharmaceutical companies have been allowed to advertise prescription drugs directly to consumers on television, in print, and on the Internet, a form of marketing known as **direct-to-consumer advertising (DCTA)**. The United States and New Zealand are the only industrialized nations to allow this. In 2020, pharmaceutical companies spent more than \$7 billion on DCTA to encourage consumers to demand advertised drugs from their doctors in the belief that the advertised drugs are superior to unadvertised ones. This pressures doctors to prescribe advertised drugs even if other, equally effective, and sometimes less costly medications are available.

The pharmaceutical industry justifies its high prices by pointing to the high cost of *research and development* (R&D), which is mostly testing. Actual costs for initial discovery in the laboratory are small compared to testing costs. The industry claims that R&D costs for bringing a new drug to market are about \$2 billion. Although actual data are often corporate secrets, independent researchers estimate actual R&D costs to be about half that amount. When pointed out that pharmaceutical companies spend more on advertising to consumers than they do on R&D, the industry points out that most tested drugs fail and hence do not recoup the money invested in them. Whereas this is true, the industry's 18% profit margin is evidence that the costs of failures do not threaten the industry's financial solvency.

Besides making it hard for many people to afford needed medicines such as insulin and anticancer drugs, high drug prices and the legal rules that permit them distort health priorities. For example, because there are no limits on what a drug company can charge for a drug, it is much more profitable for it to sell a drug that extends life for a few weeks or months to a few hundred patients than it is to develop and market an inexpensive antibiotic intended for millions (Emanuel, 2019).

Nutraceuticals

Nutraceuticals are dietary supplements that are intended to alter one or more of the body's physiological systems to produce a specific biological or psychological effect—the definition of a drug. For example, someone might take capsules of a plant extract intending to prevent heart disease or cancer. Or someone may drink a particular tea to combat depression. Unlike prescription drugs, nutraceutical products are not tested for safety or efficacy. Moreover, nutraceutical products are not inspected before going to market, which means that they may be contaminated with impurities, toxic metals, bacteria, and even prescription medications. The U.S. Food and Drug Administration forbids nutraceutical manufacturers to market products for the purpose of treating, diagnosing, preventing, or curing diseases—for example, claiming on the product label or in an advertisement that a product “lowers high cholesterol” or “treats heart disease.”

Herbal Medicines

Herbal medicines consist of materials derived from plants that can be prepared as pills, teas, extracts, tinctures, salves, and other forms. For thousands of years, people have used herbal medicines to treat all manner of ailments (Culpeper, 1653), and the practice continues today. An estimated 80% of the world's population, in both less-developed and wealthy countries, rely on herbal medicines as a primary part of their health care (Ekor, 2013). Several factors contribute to this extensive use of herbal medicine, including claims of effectiveness, a belief that “natural” therapies are superior to manufactured ones, dissatisfaction with the results from and high cost of orthodox pharmaceuticals, and loss of confidence in Western physicians and a resultant turn toward self-medication (Bandaranayake, 2006).

Certain people should be extremely careful about taking herbal medicines because the active chemicals in them can have strong effects or can combine with prescription drugs to produce harmful and even life-threatening effects. Extra care with herbal medicines should be taken when pregnant or breastfeeding, prior to surgery, and for those younger than 18 or older than 65 (Mayo Clinic, 2021).

Freedom's just another word for nothing left to lose.

—**Janis Joplin**, American musical legend, from the Kris Kristofferson song, “Me and Bobby McGee”

Unlike pharmaceutical and some OTC drugs, herbal medicines do not undergo premarket scientific testing for safety and efficacy. Regulatory agencies may demand proof of safe and clean manufacturing methods, and they have the power to block the sale of an herbal product if they believe it contains harmful ingredients.

This does not mean that herbal medicines are safe or effective, however. They can have harmful side effects just as prescription and over-the-counter drugs do. Some plants contain toxic chemicals along with the beneficial ones; the amounts of harmful and beneficial chemicals can vary from plant to plant, from season to season, and therefore among herbal medicine preparations. Moreover, a given preparation of an herbal medicine could be concocted with several different kinds of plants within each batch, without notifications of such on the product label. Because manufacturers of herbal medicines are not required to determine the amount of the specific active chemicals in their herbal products, consumers can never be sure of the chemical contents of an herbal medicine.

Manufacturers of herbal medicines can claim on the product label that their product might affect the organs or systems of the body, but they cannot claim that the product can diagnose, cure, mitigate, or treat a disease by name. Product labels must include a disclaimer stating that the product has not been approved by a regulatory agency and that it is not intended to diagnose, treat, cure, or prevent any disease. Because they are not subject to close scrutiny by government health regulators, consumers are advised to be cautious when using these products and to consult a physician or pharmacist when in doubt and about any symptoms or conditions resulting from the use of an herbal medicine.

Drug Misuse, Abuse, and Addiction

For thousands of years, humans have been ingesting substances to heal wounds, treat disease, prevent illness, enhance religious and spiritual experiences, change consciousness, produce sleep, drive out evil spirits, have fun, and promote tribal and social harmony. For most of that time, such substances were obtained by chewing the leaves of a particular plant, brewing a tea from a plant's bark or roots, or mixing a potion of plant and animal materials, as the three witches in Shakespeare's *Macbeth* did when they concocted "eye or newt, and toe of frog, wool of bat, and tongue of dog." Today, while some substances used for medicinal and nonmedicinal purposes are still obtained from plant and animal sources, nearly all modern drugs are manufactured by modern chemical and biological technologies.

There is little doubt many modern drugs and medicines are of enormous value in relieving pain, preventing disease, and facilitating healing. However, indiscriminate and inappropriate use and overuse of substances also are major problems in many human societies. For example, overuse of antibiotic drugs has led to the creation of antibiotic-resistant bacteria, against which only a few, if any, antibiotics are effective. Recently in North America, widespread use of opium-like substances (opioids), intended for use as medically prescribed pain relievers, have become widely abused, often to the point of severe illness and death (see the Dollars & Health Sense box, "The Opiate Tragedy and Deaths of Despair"). Each year worldwide, tobacco use is responsible for about 8 millions deaths; alcohol is responsible for 3 million deaths. Millions of North Americans become sick and thousands die from unforeseen, adverse reactions to prescription medications (U.S. Department of Health and Human Services, 2021). Governments of the world engage in a seemingly endless and unsuccessful "war on drugs," which is concerned as much with the social and legal problems

associated with the use of opioids, stimulants, and other drugs than with community and personal health.



Screen Addiction to Video Games, the Internet, TV

Binge-Watching, and Smartphones

Do . . .

- you often stay on-screen longer than you intended to (“just a few more minutes”)?
- your academics suffer because you spend too much time on-screen?
- you check your social media and email before starting something you must do, including sleep?
- others complain about the amount of time you spend on-screen?
- you feel depressed, moody, or nervous when off-screen, which goes away once you are back on-screen?
- you sometimes try to limit the amount of time you spend online and fail?

If you answered “yes” to any of the above, then you may be on the road to screen addiction.

The word *addiction* is almost always applied to drug use. However, because of recent advances in brain science, *addiction* can refer to a set of reward, motivation, and memory processes in the brain that underlie addiction to a variety of behaviors, including drug use, uncontrolled overeating, sexual activity, compulsive gambling, compulsive video game play, TV binge-watching, and extensive use of the Internet and smartphones.

Although no scientific evidence suggests that excessive screen time carries the same health risks as tobacco smoking and alcohol or opioid abuse, some research suggests that overuse of screen devices is associated with an increased risk of anxiety, depression, stress, overweight, lack of sleep, social isolation, and the masking of underlying mental health problems such as depression or anxiety (Substance Abuse and Mental Health Services Administration, 2017).

As of yet, scientists have not determined the daily amount of screen time that could be deemed unsafe. However, you can get a sense of how screen time may be affecting your life by keeping a diary or journal of your on-screen activities for 1 week. Count your daily texts, tweets, and the number of times you check Instagram, Facebook, and Snapchat. Keep a log of time spent playing video games, using the Internet, and TV binge-watching. Notice and record when you find yourself anticipating or fantasizing about going on-screen again, or if you snap, yell, or act annoyed if someone bothers you while you are on-screen. If you think you are developing an addiction to on-screen activities, consult your campus health center for recommendations and referrals.



The Opioid Tragedy and Deaths of Despair

Beginning in 2012, the United States and Canada began to experience an unexpected onslaught of deaths from opioid overdoses (**Figure A**).

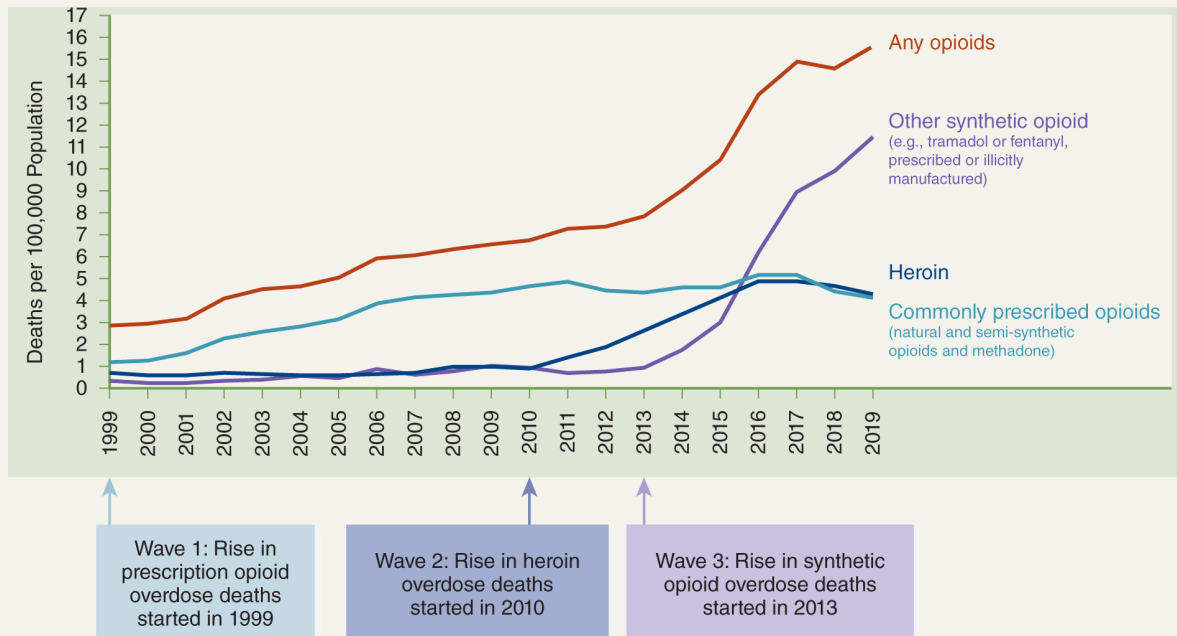


Figure A Three Waves in the Rise of Opioid Overdose Deaths. From 1999 to 2019, nearly 500,000 people died from an overdose involving any opioid, including prescription and illicit opioids. This rise in overdose deaths occurred in three waves. The first wave began with increased prescribing of opioids in the 1990s. The second wave began in 2010, with rapid increases in overdose deaths involving heroin. The third wave began in 2013, with significant increases in overdose deaths involving synthetic opioids, particularly those involving illicitly manufactured fentanyl.

Understanding the epidemic. U.S. Centers for Disease Control and Prevention (2021).

<https://www.cdc.gov/drugoverdose/epidemic/index.html>

Description

From 1999 to 2019, nearly 500,000 people died from an overdose involving opioids, including prescription and illicit opioids. This rise in overdose deaths occurred in three waves. The first wave began with increased prescribing of opioids in the 1990s. The second wave began in 2010, with rapid increases in overdose deaths involving heroin.

The third wave began in 2013, with significant increases in overdose deaths involving synthetic opioids, particularly those involving illicitly manufactured fentanyl.

Most of the affected individuals were Caucasian males between the ages of 45 and 54 who lived in regions of the eastern United States and Canada that had been devastated by the loss of blue-collar jobs, intergenerational poverty, and little opportunity for upward social and economic mobility. When jobs disappeared, replacement job opportunities were not available, and many that were open eluded individuals without requisite education and skills.

Many of those coping with near-permanent unemployment, loss of social status, destruction of close-knit communities and the social support they provide, and loss of hope experienced low back pain, for which they sought medical help in the form of prescription opioids such as oxycontin. Low back pain and depression are closely associated (Pinheiro et al., 2015). Opioids are highly addicting, chemically related substances that include opium, morphine, heroin, codeine, methadone, oxycodone, dextromethorphan, oxycontin, and fentanyl. Taken in large amounts (“overdose”) opioids can be fatal, with cause of death usually inhibition of the brain’s breathing control system.

To increase profits, some manufacturers of opioids knowingly and falsely claimed that newer formulations of their products were not addictive. This false claim encouraged doctors to prescribe these substances and patients to take them liberally. In some instances, unethical doctors and pharmacists distributed many hundreds of needless opioid prescriptions just to make money.

When prescriptions for opioids expired and doctors were legally or ethically not permitted to refill them, users who had become addicted to opioids obtained more of the drugs from unscrupulous doctors and pharmacists and nonmedical (illegal) sources. Unsupervised opiate use and impure street opioids led to many thousands of needless overdose deaths.

As it unfolded, the opioid tragedy was treated as a medical problem (even using the word *epidemic* to describe it), with alternative drugs prescribed to wean individuals from the dangerous opioids as treatment and the strategy of harm reduction (sterile needle and syringe services). However, research ultimately showed the opioid tragedy (and similar trends in suicide and deaths from alcohol abuse) to be a catastrophic example of the influence of social and economic factors on health. For this particular group of individuals, opioid overdose, suicide, and fatal alcohol abuse were termed *deaths of despair* (Case & Deaton, 2020; Monnat, 2019).

By 2016, legal authorities began to rein in unfettered prescribing of opioids by doctors and clinics and also began to prosecute pharmaceutical companies for their overzealous sales tactics and lies and half-truths about the safety of their opioid-containing products. Unfortunately, the COVID-19 pandemic and resultant economic crisis drew attention away from the opioid tragedy and stalled many attempts to mitigate the factors that spawned it—for example, the financial collapse of opioid-addiction treatment centers. Thus, by 2020, opioid deaths continued, principally from illegal distribution of fentanyl and highly potent and often lethal fentanyl analogs (American Medical Association, 2020). Chronic unemployment, loss of hope, and destruction of social ties has continued, however, and await more concerted efforts to mitigate the social disparities at the root of the tragedy.

Data from American Medical Association, June 18, 2020. Reports of increases in opioid related overdose and other concerns during COVID pandemic. <https://www.ama-assn.org/system/files/2020-06/issue-brief-increases-in-opioid-related-overdose.pdf>

The use of drugs to enhance life is so commonplace and accepted that many people automatically turn to drugs to solve their physical, mental, emotional, and spiritual problems, failing to appreciate the values of nondrug alternatives or understand fully the associated dangers of drug use of any kind. Many drugs are used to change consciousness and avoid the distress of life's problems. In some incredibly difficult life situations, drug-induced psychological dissociation may be a suitable way to cope with hardship and horror. On the other hand, reliance on drugs to deal with life's problems is much more likely to mask rather than solve them, and such reliance may also open the way to chemical dependency (drug addiction).

Drug Misuse

Modern prescription and over-the-counter drugs and medicines are manufactured and distributed for specific medical purposes. The label on every container of a therapeutic substance describes the medical indications for its use, the appropriate dose, and, for a prescription medication, the name of the intended user. Regardless of intention, millions of people misuse medications, especially pain relievers, stimulants, tranquilizers, and sedatives, by taking them not in accordance with a label's instructions or a physician's directions. This includes (1) using a drug for a condition other than that for which the drug is intended, (2) taking more of a drug than prescribed or at different dosing intervals, (3) individuals using a drug for therapeutic purposes even though it was not prescribed for them, and (4) individuals taking a drug or medicine for nontherapeutic reasons. For example, about 4% of North American college students consume prescription stimulants, sedatives or sleeping pills, and opioids without a prescription, or they take their own prescriptions more often than prescribed (American College Health Association, 2020). Students misuse stimulants to study harder and to enhance performance on tests, sedatives to improve sleep and relieve anxiety, and opiates to get high and to relieve pain (American College Health Association, 2020).

Drug Abuse

Drug abuse is using any substance to the point at which health is adversely affected or the ability to function in society is impaired. Characteristics of drug abuse include the following:

- failure to fulfill major obligations at work, school, or at home (e.g., repeated absences or poor performance at work or school; neglect of children or the household);
- recurrent substance use in situations in which it is physically hazardous to self or others (e.g., overdose, toxicity, driving an automobile, or operating a machine);
- recurrent substance-related legal problems (e.g., driving while under the influence, drug-related arrests).
- continued substance use despite having persistent or recurrent social or interpersonal problems exacerbated by the effect of the substance (e.g., arguments with spouse, physical fights).

Any substance taken to mask anxiety or facilitate undesirable behaviors is being abused. If a substance is used continually to combat stress and anxiety, it is being abused. If experiencing pleasure is possible only when taking a substance, it is being abused. If someone cannot control his or her personal use of a substance, it is being abused.

Most of the commonly abused substances are **psychoactive**, meaning they affect thoughts, perceptions, feelings, and moods (**Table 13.3**). Whether taken to “feel good,” block unpleasant feelings, or induce an unusual state of consciousness, psychoactive substances are associated with the following risks:

TABLE 13.3 Classification of Drugs That Affect the Central Nervous System

Drug Classification	Common or Trade Name	Medical Uses	Effects of Average Dose	Physical Dependence	Tolerance Develops
Opiates	Codeine Darvon Demerol Fentanyl Heroin Methadone Morphine Opium Oxycontin Percodan Vicodin Dextromethorphan	Analgesic (pain relief) Cough suppressant	Blocks or eases pain; may cause drowsiness and euphoria; some users experience nausea or itching sensations	Marked	Yes
Sedatives	Amytal Nembutal Phenobarbital Seconal Doriden Quaalude Halcion	Sedation, tension relief	Relaxation, sleep; decreases alertness and muscle coordination	Marked	Yes
Minor tranquilizers	Dalmane Equanil, Miltown Librium Valium Xanax	Anxiety relief, muscle tension relief	Mild sedation; increased sense of well-being; may cause drowsiness and dizziness	Marked	No
Major tranquilizers (phenothiazines)	Mellaril Thorazine Prolixin	Psychosis control	Heavy sedation, anxiety relief; may cause confusion, muscle rigidity, convulsions	None	No
Alcohol	Beer Wine Distilled liquor	None	Relaxation; loss of inhibition; mood swings; decreased alertness and coordination	Marked	Yes
Inhalants	Amyl nitrite Butyl nitrite Nitrous oxide	Muscle relaxant, anesthetic	Relaxation, euphoria; causes dizziness, headache, drowsiness	None	?
Stimulants	Benzedrine Biphetamine Desoxyn Dexedrine Methedrine Preludin Ritalin	Weight control; relief from narcolepsy, fatigue, and hyperactivity in children	Increased alertness and mood elevation; less fatigue and increased concentration; may cause insomnia, anxiety, headache, chills, and rise in blood pressure; organic brain damage after prolonged use	Mild to none	Yes
Cocaine	Cocaine hydrochloride	Local anesthetic, pain relief	Effects similar to stimulants	Marked	No
Cannabis	Marijuana Hashish	Relief of glaucoma, asthma, nausea accompanying chemotherapy	Relaxation, euphoria, altered perception; may cause confusion, panic, hallucinations	Mild to none	No
Hallucinogens	LSD	None	Altered perceptions, visual	None	Yes

hallucinogens	LSD PCP Mescaline Peyote Psilocybin	None	Altered perceptions, visual and sensory distortion; mood swings	None	Yes
Nicotine	(In tobacco)	None	Altered heart rate; tremors; excitation	Yes	Yes

Description Description

1. By changing thoughts and emotions, psychoactive substances can alter the harmonious, natural adaptation to one's environment. Emotions help evaluate the status of an individual's interaction with the real world. Substances that induce pleasant emotions can give a false sense of harmony and benefit. Substances that block uncomfortable emotions (e.g., sadness, fear) can impair successful coping.
2. Regular use of psychoactive substances can alter the biology of the brain to the point that substance use becomes an end in itself (addiction), irrespective of any desire to alter thoughts and feelings.
3. Often people consume psychoactive drugs with alcohol, especially at parties or while at clubs. This increases the risk of overdose and erratic behavior. Moreover, the nonmedicinal substances distributed as psychoactive drugs are often mixed with other chemicals of unknown identity and quantity, resulting in a potentially harmful or even fatal combination.

Drug Addiction

Drug addiction is a progressive, chronic biological condition characterized by the following qualities.

- *Compulsion*: an overwhelming preoccupation, desire, or drive to use a substance, which can include obsessive thinking about the substance, seeking the substance, and substance-hoarding behavior.
- *Loss of control*: the inability to control one's personal use of a substance or loss of control over one's behavior because of using the substance (e.g., impulsive actions, verbal and physical violence, impulsive sexual behavior).
- *Continued use of the substance despite adverse consequences*: the tendency not to stop substance use in the face of arrest, job loss, family breakdown, and severe health problems.
- *Distortions in normal thinking*: not admitting that problems are the result of one's substance use (denial).

Many people who are addicted to substances have coexisting mental health issues such as depression and any of the common anxiety disorders.

Addiction is the result of changes in the structure and function of the brain's reward system, consisting of brain cells responsible for "feeling good." Addiction is chronic and progressive: it tends to worsen over time. Family members who wait for an addicted family member to "get better" on their own are generally gravely disappointed.

Physical Dependence

Addiction is often associated with **physical dependence** (also called *tissue dependence*), which is the biological adaptation to long-term exposure to a substance. First-time or infrequent use of a psychoactive substance causes intoxication because the body rids itself of the active chemicals before biological balance in the brain occurs. With regular and extended use of a drug, however, actual physical changes take place in brain tissues to adapt to the continued presence of the substance.

Both legal and illegal drugs can cause physical dependence. The legality of a drug is more a function of social, political, and economic considerations than its toxicity or pharmacology. From a personal and community health standpoint, alcohol and tobacco addiction cause far more harm than all other substances combined, yet their use is legal.

Tolerance

Tolerance is an adaptation of the body to a drug so that larger doses are needed to produce the same effect. Thus, the longer one regularly consumes a drug, the higher the doses that person will require. Not all parts of the body become tolerant to a drug's effects to the same degree. For example, heroin and barbiturate users may become tolerant to their drugs' psychological effects before the brain's breathing center does. This is the cause of respiratory failure with overdose.

Withdrawal

Withdrawal, or *abstinence syndrome*, occurs when the body tries to adapt to the absence of a drug to which it has become physically dependent. Withdrawal is often unpleasant and sometimes fatal. For example, someone physically dependent on an opioid may experience anxiety, pain, sweating, muscle cramps, frightening hallucinations, and fatal seizures when deprived of the drug. The fear of experiencing the horrors of withdrawal may be a stronger motivator of continued use than the effects of the drug itself.

Habituation/Psychological Dependence

Besides physical dependence, substance abuse can be sustained by **habituation** or **psychological dependence**, which manifests as intense craving for the drug. Habituation becomes injurious when a person becomes so consumed by the need for the desired drug state that all of his or her life energy is siphoned into compulsive drug seeking and its consequences: the loss of health and the destruction of relationships, family, and job

Commonly Abused Drugs

Stimulants

Stimulants are substances that increase the activity of the central nervous system. These drugs include cocaine, amphetamine, methamphetamine and similar drugs, and caffeine. Their main effects are an increase in mental arousal and physical energy and production of a state of euphoria, which is why they are referred to as *uppers*. Stimulants also can cause restlessness, talkativeness, and difficulty sleeping. Long-term use of stimulants tends to produce physical and psychological dependence.

Cocaine

Cocaine is obtained from the leaves of the coca shrub, *Erythroxylum coca*, a plant indigenous to the Andes. For hundreds of years, inhabitants of Peru, Bolivia, and Colombia have chewed coca leaves to obtain a moderate stimulant effect intended to overcome fatigue. In the late 19th century, Angelo Mariani received a medal from the pope for manufacturing an extract of coca leaves that “freed the body of fatigue, lifted the spirits, and induced a sense of well-being.” In the United States in the 1880s, Atlanta pharmacist J. C. Pemberton mixed extracts of coca leaves and kola nuts to produce Coca-Cola, claimed at the time to be not only refreshing but also

“exhilarating, invigorating, and a cure for all nervous afflictions.” Today, of course, the drink Coke no longer contains cocaine, although cocaine-free extracts of coca leaves are still used for flavoring. Sigmund Freud extolled the use of cocaine as a mood elevator, a possible antidote to depression, and a treatment for morphine addiction. However, witnessing a friend’s severe and terrifying psychotic reaction to cocaine tempered Freud’s enthusiasm for the drug.

As an illegal recreational drug, cocaine is most commonly taken into the body by sniffing it as a white powder (*snorting*), injecting it directly into the bloodstream (an obvious risk factor for AIDS), or smoking *free base* or *crack* cocaine. Each method rapidly produces euphoria, a sense of power and clarity of thought, and increased physical vigor. The drug’s effects last from minutes to an hour, depending on the dose and the route of administration into the body. After the initial high, users tend to experience a letdown (*crash*) and an intense craving for more of the drug.

Cocaine increases heart rate and blood pressure. Continued use of the drug can result in appetite and weight loss, malnutrition, sleep disturbance, and altered thought and mood patterns. Frequent cocaine sniffing can inflame the nasal passages and cause permanent damage to the nasal septum. An overdose can cause seizures or death. Pregnant women who ingest cocaine risk giving birth to cocaine-addicted babies, who may be permanently disabled or even die in infancy.

Cocaine produces tolerance, physical dependence, and withdrawal. The potential for psychological dependence is great, probably the greatest among all psychoactive drugs. Some people develop such a strong craving for the drug that their lives are consumed by their cocaine habit.

Amphetamines

Amphetamines are manufactured chemicals that stimulate the central nervous system. The most common amphetamine substances are dextroamphetamine, methamphetamine,

dextromethamphetamine, and amphetamine itself. Amphetamines are usually taken orally, but they can also be injected (*mainlined*) and smoked. The effects of an oral dose usually last several hours. Slang terms for amphetamines include *dexies*, *footballs*, *orange*, *bennies*, *peaches*, *meth*, *crystal*, *speed*, and *ice*.

Although amphetamines may be used medically to treat narcolepsy and attention deficit hyperactivity disorder (ADHD), they are principally used (illegally) to produce feelings of euphoria, increased energy, and greater self-confidence; an increased ability to concentrate; increased motor and speech activity; a perception of improved physical performance; and appetite suppression. Besides being used by those who wish to experience an amphetamine high, these drugs are frequently abused by people who fight sleep such as students cramming for exams, entertainers, and truck drivers.

Excessive amphetamine use can cause headaches, irritability, dizziness, insomnia, panic, confusion, and delirium. The user often experiences a *crash* when the stimulants wear off, during which he or she usually is depressed and tired and sleeps for long periods.

Prolonged use of amphetamines can lead to tolerance, especially for the euphoric effects and for appetite suppression. Amphetamines can cause mild physical dependence and create a psychological dependence; a particular pattern of use called the *yo-yo* is a cycle of amphetamine use for the stimulatory effect followed by use of a depressant to sleep, followed by more amphetamines the next day to get going. Chronic use can cause an amphetamine psychosis, consisting of auditory and visual hallucinations, delusions, and mood swings.

A particularly dangerous form of amphetamine is *ice*—a smoked form of pure methamphetamine hydrochloride. The inhaled drug reaches the brain almost immediately, producing a high that can last for several hours. Because the drug can be so easily inhaled, the potential for compulsive use, tolerance, and abuse is also considerable. This amphetamine is manufactured at clandestine laboratories; the purity of the drug varies considerably from one laboratory to another, which adds to the risks of abusing it.

The prescription medications Adderall and Ritalin are amphetamines obtained illegally by some college students to promote alertness when studying, preparing assignments, or taking tests. Adderall is a combination of amphetamine and dextroamphetamine; Ritalin is an amphetamine derivative, methylphenidate. These drugs are medically indicated for the treatment of ADHD. Several million prescriptions for them are written for children and young adults diagnosed with ADHD, so these drugs are widely available. Patients or their siblings sell ADHD medicine to other students, who tend to use it periodically rather than chronically. That they are medicines may lead users to believe incorrectly that they are harmless. These drugs are potent stimulants with unpleasant side effects; in high doses (such as when snorted), they can cause irregular heartbeat, stroke, and death.

Club Drugs

Club drugs consist of several psychoactive chemicals that are used at parties, dances, festivals, and raves to enhance social experiences and increase sensory stimulation. These include Ecstasy, GHB, ketamine, and Rohypnol (flunitrazepam). Compared to marijuana, amphetamines, hallucinogens, and opiates, club drugs are believed to give a sense of emotional closeness and euphoria (so-called entactogens), carry little or no risk for addiction, and, because they are ingested orally, no risk of contracting HIV/AIDS from injection. Despite these seeming benefits, club drugs can be dangerous, especially when taken together with alcohol or other drugs. Also, something sold as a club drug often is some other substance unknown—and possibly dangerous—to the user.

Ecstasy

Ecstasy (MDMA) is chemically 3,4-methylenedioxymethamphetamine, which is abbreviated MDMA. Some of its common nicknames are *Adam*, *XTC*, *Clarity*, and *Essence*. Ecstasy is a synthetic chemical—that is, it does not occur

naturally in plants. The substance has a chemical structure similar to the stimulant methamphetamine and the hallucinogen mescaline, and it can produce both stimulant and psychedelic effects. Ecstasy is most often available in tablet form and is taken orally. It also is available as a powder; it is sometimes snorted and occasionally smoked but rarely injected.



Most Americans consume more soft drinks than glasses of water. This can mean a significant daily intake of caffeine and calories.

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Ecstasy increases levels of the neurotransmitter serotonin in the brain, producing a high that lasts from several minutes to an hour. The drug's rewarding effects vary with the individual taking it and with the dose, purity, and the environment in which it is taken. Ecstasy can produce stimulant effects, such as an enhanced sense of pleasure and self-confidence and increased energy. Its

psychedelic effects include feelings of peacefulness, acceptance, and empathy. Users claim they experience feelings of closeness with others.

The risks associated with using Ecstasy are similar to those found with the use of amphetamines and cocaine:

- confusion, depression, sleep problems, drug craving, severe anxiety, and paranoia during and sometimes weeks after taking the drug;
- muscle tension, involuntary teeth clenching, nausea, blurred vision, rapid eye movement, faintness, and chills or sweating;
- increases in heart rate and blood pressure;
- long term damage to serotonin-producing nerve cells in the brain; and
- liver damage with long-term use.

Ecstasy-related fatalities have been reported. The stimulant effects of the drug, which enable the user to dance for extended periods, combined with the hot, crowded conditions usually found at raves, or parties, can lead to dehydration, hyperthermia, and heart or kidney failure.

GHB

Chemically known as **gamma-hydroxybutyrate (GHB)**, GHB's street names include *Georgia home boy*, *liquid ecstasy*, and *grievous bodily harm*. GHB is ingested as a white powder or a clear, bitter-tasting liquid, which is often mixed with sweet alcoholic beverages to mask the bitter taste. This is often the way GHB is "slipped" into an unsuspecting person's drink. The drug's effects begin about 30 minutes after ingestion and can last several hours.

At low doses (–10 mg/kg body weight), GHB produces light sedation, increased sexual interest, relaxation, and short-term

amnesia—the mental state sought in much of club drug use and that which increases the risk of sexual assault (*date rape*). At moderate doses (–20 mg/kg), users become lethargic. At large doses (–60 mg/kg), users can become comatose and stop breathing. More than half of the users of GHB at low doses experience unconsciousness, vomiting, and profuse sweating.

After more than 60 deaths were reported from GHB use, the U.S. government classified the drug as a Schedule I controlled substance and was removed from the market. Chemical relatives of GHB are sold as dietary supplements—GBL (gamma-butyrolactone), and BD (1-4-butane diol)—are converted naturally to GHB in the body.

Ketamine

Ketamine is an anesthetic. Its street names include *K*, *special K*, *vitamin K*, and *black hole*. Mixing ketamine with MDMA (Ecstasy) is called *kitty flipping*; mixing it with MDMA and marijuana is called *EGK* (Ecstasy, ketamine, marijuana). *Trail mixes* are ketamine mixed with other drugs such as methamphetamine, cocaine, Viagra, or heroin.

As a recreational drug, ketamine is generally ingested orally as a white powder or intranasally with an inhaler (called a *bumper*). It can also be administered by injection. After oral ingestion, drug effects occur after about 30 minutes and last up to 3 hours. At extremely low doses, ketamine can produce an out-of-body dissociative state and hallucinations (called *k-land*). At high doses, ketamine can produce muscular rigidity, bizarre behavior, psychosis, and social withdrawal.

Rohypnol

Rohypnol is a powerful tranquilizer. It reduces anxiety, inhibition, and muscular tension. At higher doses it can cause unconsciousness. Its effects are dangerously compounded when taken with alcohol or other sedating drugs. Chronic use can produce dependence and withdrawal symptoms.

Depressants

Depressants comprise a vast number of drugs whose common effects include a reduced level of arousal, motor activity, and awareness of the environment and increased drowsiness and sedation. The depressants include alcohol and drugs that affect sleep: sedatives, hypnotics, and opiates. A number of other drugs such as antihistamines and some medications used in the treatment of high blood pressure or heart disease may also act as depressants. In low doses, depressants produce a mild state of euphoria, reduce inhibitions, or induce a feeling of relaxation. In high doses, they may impair mood, speech, and motor coordination.

Depressants are dangerous. All carry the potential for physical and psychological dependency, tolerance, unpleasant withdrawal symptoms, and toxicity from continual use or overuse. Acute overdoses may produce coma, respiratory or cardiovascular collapse, and even death. Aggravating the potential for lethal overdose are the *synergistic actions* of depressants. In other words, when taken together, two or more different depressants can produce a much stronger effect than the sum of both drugs. The most common synergistic effect occurs when people drink alcohol while taking depressant medications such as barbiturates or tranquilizers.

Sedative and Hypnotic Drugs

A **sedative** is a drug that promotes mental calmness and reduces anxiety. A **hypnotic** is a drug that promotes sleep or drowsiness. Because of their potential for inducing dependence, almost all sedatives and hypnotics are highly regulated and are available only by prescription. Nevertheless, sedative-hypnotics are among the most widely used drugs in the United States.

The most common sedative-hypnotics are drugs called *benzodiazepines*, more popularly known as **tranquilizers**. Medically, these drugs are used to relieve anxiety, promote relaxation, induce

sleep, alleviate muscle spasm and lower back pain, treat convulsive disorders, and lessen the discomfort of alcohol and opiate withdrawal. Benzodiazepines are most helpful when used on a short-term basis (a few weeks) as an adjunct to psychotherapy or medical therapy. Long-term use (more than 4 months) increases the risk of both dependence and of not confronting and overcoming issues and symptoms for which the benzodiazepines were originally prescribed.

Barbiturates are sedative-hypnotic drugs that include barbituric acid and its derivatives: amobarbital (Amytal), pentobarbital (Nembutal), phenobarbital (Luminal), secobarbital (Seconal), and Tuinal (50% amobarbital plus 50% secobarbital). Because they are less safe than benzodiazepines, barbiturates tend not to be prescribed for medical conditions that call for sedative-hypnotic drug therapy.

Opiates

The **opiates** are a group of chemically related drugs that depress the central nervous system (e.g., morphine, heroin, codeine, Demerol [meperidine], Duragesic [fentanyl], Oxycontin [oxycodone], Percodan [aspirin and oxycodone], Vicodin [acetaminophen and hydrocodone]). They can cause physical dependence, habituation, and tolerance and produce serious withdrawal symptoms. Opiates are derived from the opium poppy, *Papaver somniferum*, extracts of which have been used for thousands of years in a variety of cultures to produce euphoria, relieve pain, and treat various diseases.

Medically, opiates are used for pain relief, cough suppression, and treatment of diarrhea. They can be taken by mouth, injection, snorting, and smoking. Heroin is converted to morphine in the body, and the morphine is eventually excreted in urine, saliva, sweat, and the breast milk of lactating women (which means that nursing infants can become addicted). Because morphine crosses the placenta, a developing fetus may become addicted even before birth and may experience withdrawal symptoms after it is born.

Opiates are commonly abused substances taken for their pain-relieving and psychoactive effects (see the Dollars & Sense box “The Opioid Tragedy and Deaths of Despair”). The psychological sensations produced by opiates include feelings of warmth and belonging, relaxation, and mellowness. Regular use of opiates can produce tolerance to the psychological effects, constipation, loss of appetite, depression, loss of interest in sex, constriction of the pupil of the eye, disruption of the menstrual cycle, and drowsiness. Larger doses or prolonged use can be fatal because of respiratory failure.

Hallucinogens

The **hallucinogens** comprise a variety of chemical substances derived from as many as 100 kinds of plants as well as by chemical synthesis in the laboratory (**Table 13.4**). Despite their chemical differences, hallucinogens share the ability to alter perception, thought, mood, sensation, and experience. The similarity of their effects to psychotic hallucinatory experience is one reason they are called *hallucinogens*, but in many respects the psychedelic drug experience is not the same as a psychotic hallucination. Psychotic hallucinations are generally auditory and frightening, and the hallucinator believes them to be real. Drug-induced hallucinations tend to be visual, are usually enjoyable, and the individual is aware that the experience is unusual and not part of his or her normal state of consciousness.

TABLE 13.4 Substances Considered to Be Hallucinogenic or Psychedelic	
Substance or Active Ingredient	Common Name
D-lysergic acid diethylamide	LSD
Trimethoxy phenylethylamine	Mescaline (peyote)
2,5-dimethoxy-4-methylamphetamine	STP
Dimethyltryptamine	DMT
Dimethyltryptamine	DET
Tetrahydrocannabinol	Marijuana (cannabis)
Phencyclidine	PCP

Substance or Active Ingredient	Common Name
Psilocybin	Mushrooms

Hallucinogens are most often ingested orally, either by eating the plant itself or by ingesting powder containing the active chemical. Normally, a hallucinogenic drug begins to take effect in 45 to 60 minutes. The first effects are physical: sweating, nausea, increased body temperature, and pupil dilation. These symptoms eventually subside, and the psychological effects become manifest within an hour or two of ingestion. Depending on the particular substance and the amount ingested, the *trip* lasts anywhere from 1 to 24 hours. Perhaps the most commonly used hallucinogen is LSD (D-lysergic acid diethylamide), commonly called *acid*.

A common feature of the hallucinogenic experience is the suspension of the normal psychic mechanisms that integrate the self with the environment. The distortion of self–environment interactions makes the user extremely open to conditions in the surroundings. For this reason, experience in any particular drug episode is highly influenced, for better or worse, by the environmental setting in which the trip takes place and by the user's *psychic set*—his or her expectations and attitudes.

Phencyclidine (PCP)

Phencyclidine (PCP), also known as *angel dust*, *hog*, *crystal*, and *killer weed*, was developed originally for medical use as an animal anesthetic. But because of the drug's many adverse effects, it was removed from legal sale and became an illegal recreational drug. In the 1960s, phencyclidine was called the “PeaCePill”—a serious misnomer in view of the drug's effects.

Insanity is doing the same thing over and over again and expecting a different outcome.

Depending on the dose and the route of administration, PCP can be a stimulant, a depressant, or a hallucinogen. Some of the intended effects are heightened sensitivity to external stimuli, mood elevation, relaxation, and a sense of omnipotence. Some of the common unintended effects are paranoia, confusion, restlessness, disorientation, feelings of depersonalization, and violent or bizarre behavior. In high doses, the drug can cause coma, interrupted breathing, and psychosis.

Many admissions to psychiatric emergency rooms are for PCP intoxication. The drug impairs perception and muscular control, and users are prone to accidents such as falling from heights, drowning, walking in front of moving vehicles, and collisions while driving under the influence of the drug. PCP does not induce tolerance or physical dependence, but because it is eliminated slowly from the body, chronic users may experience the drug's effects for an extended period.

The effects of PCP are unpredictable and frequently unpleasant, if not terrifying and life-threatening. PCP produces more unwanted and dangerous symptoms of drug intoxication than any other psychoactive substance. Drug dealers often surreptitiously mix PCP with marijuana or cocaine or sell PCP while claiming it to be LSD, DMT, or some other drug. Because PCP is relatively easy to manufacture, it is one of the more readily available and dangerous of the illegal recreational drugs.

Inhalants

Inhalants are a wide variety of chemical substances that vaporize readily; when inhaled, they produce various kinds of depressant effects similar to those of alcohol. Like alcohol, inhalants are depressants of the central nervous system. Generally, their intended effect is loss of inhibition and a sense of euphoria and excitement. Unintended effects include dizziness, amnesia, inability to concentrate, confusion, impaired judgment, hallucinations, and acute psychosis. Inhalants commonly used for recreational purposes include model airplane glue, nail polish remover, gasoline, acetone, toluene amyl nitrite, nitrous oxide (*laughing gas*), diethyl ether, and chloroform. The fumes are usually inhaled from plastic bags. The intoxicant effects are often felt within minutes, and the high lasts less than an hour. Regular users tend to be preteens and others without the money to buy other drugs. Some adults use amyl nitrite (*poppers*) during sexual relations, believing that the drug enhances the sexual experience. Some medical personnel are frequent users of nitrous oxide, or *laughing gas*, because it is easily available.



Inhalants are dangerous but unfortunately often readily available to kids looking for a “rush.”

The inhalant chemicals do not produce tolerance or withdrawal, nor do they induce physical dependence. However, they are dangerous. In addition to any harm resulting from uncontrolled behavior (such as driving while intoxicated), these chemicals damage the kidneys, liver, and lungs and can upset normal heartbeat.

About 2 million adolescents between ages 12 and 17 use inhalants, some beginning as young as age 7. Signs of inhalant use that adults can watch for include paint stains on clothing, red and runny eyes, chemical breath odor, sores around the mouth, and a drunken demeanor.

Anabolic Steroids

Anabolic steroids are synthetic derivatives of the male hormone testosterone. These derivatives of testosterone promote the growth of skeletal muscle and increase lean body mass. Anabolic steroids were first abused by elite athletes seeking to improve performance. Today, athletes and nonathletes use steroids to enhance performance as well as change physical appearance.

Anabolic steroids are taken orally or injected, typically in cycles of weeks or months rather than continuously. Users frequently combine several different types of steroids to maximize their effectiveness while minimizing negative side effects, a process known as *stacking*. Anabolic steroids produce increased lean muscle mass, strength, and ability to train longer and harder. Side effects of anabolic steroid use include liver tumors, jaundice, fluid retention, high blood pressure, severe acne, and trembling. Shrinking of the testicles, reduced sperm count, infertility, baldness, and development of breasts have been observed in males. In females, growth of facial hair, changes or cessation of menstrual cycle, enlargement of the clitoris, and deepened voice are among the side effects.

Reducing Drug Use

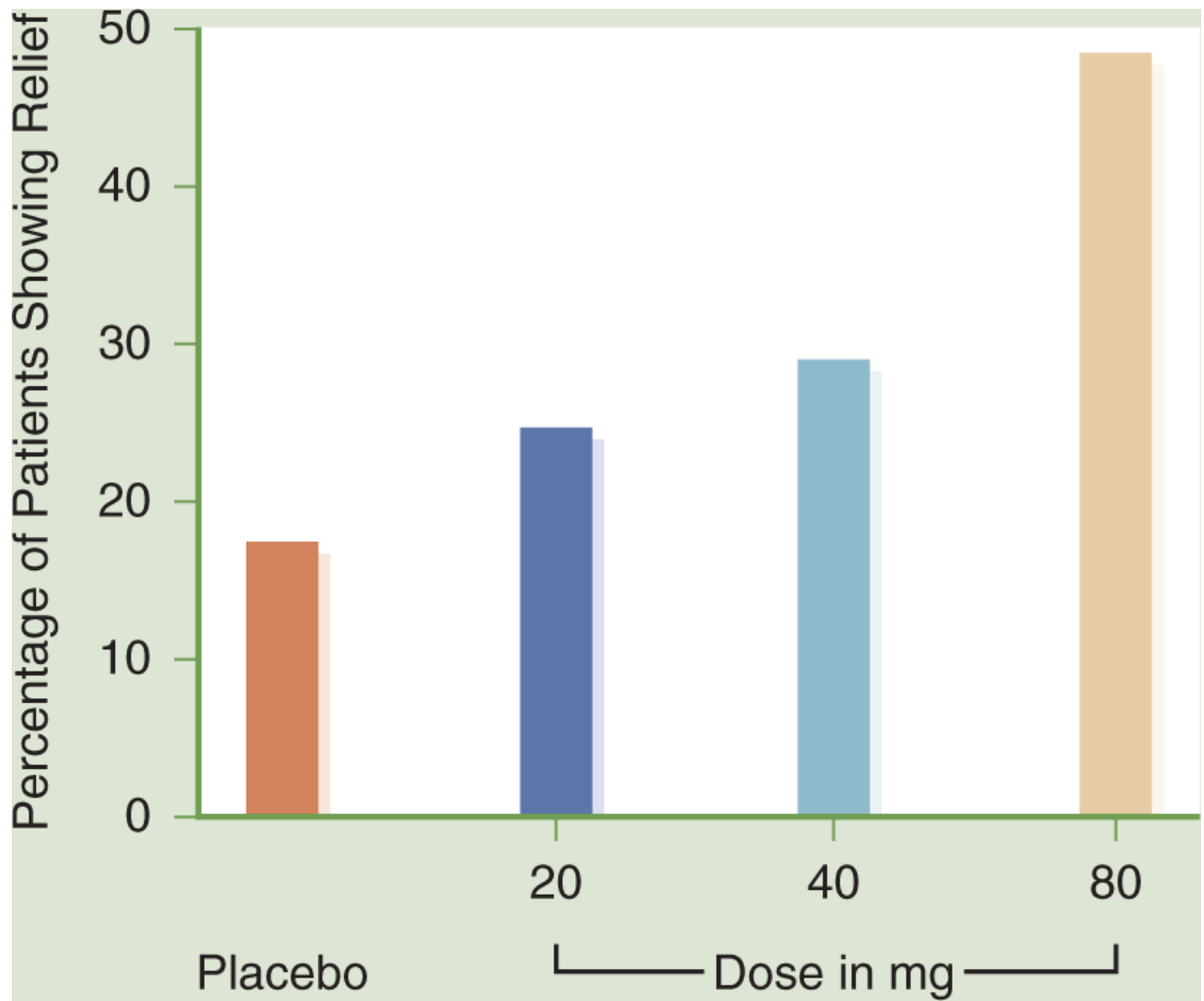
Almost everyone takes drugs of one kind or another at one time or another. People take drugs to relieve headaches, heartburn, tension, cramps, fatigue, and anxiety. Drugs are used to get to sleep and to stay awake. They are used for body problems and emotional problems. When used appropriately, prescription drugs can play a vital role in the treatment and prevention of disease.

However, as a society we are overmedicated and overly dependent on drugs. The healthiest approach is to be as free of drugs as possible. Wellness is not achieved by taking drugs. No drug should ever be taken casually, whether prescribed, over the counter, or offered in a social setting. Each person should learn when drugs are necessary to maintain or restore health and when the benefits of the drug outweigh the risks.

All drugs are dangerous, and illegal recreational drugs are especially so because a user cannot be sure of their quality or strength. The use of most recreational drugs is illegal, and if caught, users and sellers are prosecuted as criminals. Still, many people in American society, especially young people, experiment with one or more illegal drugs. Experimenting with drugs is just that: You are taking a chance of getting caught, or getting high and causing an accident, or getting the wrong dose and dying.

Critical Thinking About Health

1. The accompanying graph shows the results of a test of a new drug. Four groups of patients were involved. Group 1 received a placebo; group 2, 20 mg of the drug; group 3, 40 mg; and group 4, 80 mg.
 - a. Do the data support the hypothesis that the drug is effective? Why or why not?
 - b. What percentage of people get well without the drug? What's a likely explanation?
 - c. What's the maximum percentage of people that can be expected to get well from taking the drug?
 - d. If 80 mg produces the desired effect in the largest number of people, why didn't the experimenters report the effects of 100 mg?
2. Why are some drugs illegal? What characteristics distinguish a legal drug from an illegal one? If you had unlimited power and resources, what would you do to solve the illegal drug problem in the United States?
3. In what ways has substance use and abuse touched your life?



Description

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Before recorded human history, our ancestors accidentally left containers of ripe fruit or wet grains out in the open where microorganisms began the process of fermentation. When they drank the liquid, their thoughts and behaviors changed. They liked it. They had discovered alcohol. So began a systematic search for leaves, roots, flowers, or mushrooms that could alter thoughts, feelings, and sensations or cure various ailments. Human history and drugs became forever entwined. The shamans, witch doctors, and healers became powerful forces for new knowledge.

A drug is a chemical substance that can produce a change in human (and animal) physiology. The change can be beneficial or harmful, fast or slow acting, long lasting or temporary, addicting or nonaddicting. Many of the most effective drugs used today to treat physical and mental ailments are derived from substances originally discovered in nature. Alcohol, nicotine, opium derivatives, marijuana, and cocaine are still the most widely used drugs. Whether a drug is legal or illegal today has nothing to do with the drug's effectiveness, usefulness, or safety. Consumption of alcohol (and smoking tobacco) causes far more disease and death than all illegal drugs combined. Prescription drugs do great good as well as great harm. To preserve your health, think carefully about what drugs you ingest or inhale.

Drug abuse is a major problem in today's societies. Drug abuse really means overuse of a drug to the point where a person cannot function and has lost control of his or her life. Addiction or dependence on alcohol, heroin, cocaine, prescription pain killers, tranquilizers, or "uppers and downers" is an example of drug abuse. A person also can become physically or mentally tolerant to a drug, which means that larger doses are needed to achieve the desired effect. All drugs, legal and illegal, have secondary effects that may be dangerous or undesirable. When using any drug, be aware of

undesirable side effects or adverse reactions. There are many ways to cope with life's problems without immediately seeking a drug-related solution.

HIGHLIGHTS

- People have been ingesting drugs throughout recorded history for a variety of reasons, including altering thoughts and feelings, curing illness, and facilitating social interaction.
- A drug is a chemical substance capable of producing a change in physiology. Most drugs react by binding to receptor sites in or on cells, which alters biological activity.
- Legal or illegal, medical or nonmedical, drug use in the United States is widespread. Drug use is encouraged by extensive advertising by the pharmaceutical industry.
- The Food and Drug Administration requires the testing of new drugs for safety and efficacy before they are approved for sale.
- Drug abuse is the overuse of a drug, often to the point of loss of control. Many drugs of abuse are psychoactive, meaning that they alter thoughts, feelings, and perceptions. Many psychoactive drugs cause physical dependence; some cause psychological dependence.
- Tolerance is the adaptation of the body to repeated drug use so that ever-increasing doses of the drug are required to produce an effect.
- Commonly used psychoactive drugs in the United States include stimulants (cocaine, amphetamine, caffeine), depressants

(sedatives, tranquilizers, hypnotics), opiates, hallucinogens, cocaine, and Ecstasy.

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KEY TERMS

drug:

a single chemical substance that alters one or more of the body's biological functions

medicine:

drugs used to prevent, treat, or cure illness; aid healing; or suppress symptoms

pharmacogenetics:

tailoring drugs to a particular individual to match her or his biology

over-the-counter (OTC) drugs:

medications available for purchase at stores without a doctor's prescription

receptors:

proteins on the surface or inside of a cell to which a drug or natural substance can bind and thereby affect cell function

side effects:

unintended and often harmful actions of a drug

drug hypersensitivity:

an allergic reaction to a drug

teratogen:

any environmental agent or drug that alters development of a fetus

contraindication:

any medical reason for not taking a particular drug

adverse drug reactions (ADRs):

unintended, unpleasant, and/or harmful reactions to a medicinal product

rebound effect:

the reemergence of symptoms for which a drug is administered after the drug is suddenly stopped or the dose lessened

double-blind placebo-controlled trial:

when neither the person receiving the drug nor the person administering the drug knows whether patients receive a placebo or the drug

direct-to-consumer advertising (DTCA):

the marketing of prescription drugs to consumers to stimulate demand for a drug

drug abuse:

persistent or excessive use of a drug without medical or health reasons

psychoactive:

any substance that primarily alters mood, perception, and other brain functions

drug addiction:

physical and psychological dependence on a drug, substance, or behavior

physical dependence:

a physiological state that depends on the continuous presence of a drug; absence of the drug may cause discomfort, nervousness, headaches, and sweating (withdrawal symptoms) and sometimes death

tolerance:

a condition in which increased amounts of a drug or increased exposure to an addictive behavior is required to produce desired effects

withdrawal :

uncomfortable and sometimes dangerous reactions that occur after a person stops taking a physically addicting drug

habituation:

psychological dependence arising from repeated use of a drug

psychological dependence:

dependence that results because a drug produces pleasant mental effects

stimulants:

substances that increase the activity of the central nervous system

cocaine:

a stimulant drug, obtained from the leaves of the coca shrub, that causes feelings of exhilaration, euphoria, and physical vigor

amphetamines:

synthetic drugs that stimulate the central nervous system and sometimes produce hallucinogenic states

club drugs:

psychoactive chemicals used at parties, dances, festivals, and raves to enhance social experiences and increase sensory

stimulation

Ecstasy (MDMA):

a club drug with both stimulant and pleasurable effects

gamma-hydroxybutyrate (GHB):

a dangerous club drug with unpleasant side effects

ketamine:

an anesthetic used as a club drug

Rohypnol:

a powerful tranquilizer used as a club drug

sedative:

central nervous system depressant used to relieve anxiety, fear, and apprehension

hypnotics:

central nervous system depressants used to induce drowsiness and encourage sleep

tranquilizers:

central nervous system depressants that relax the body and calm anxiety

opiates:

central nervous system depressants derived from the opium poppy

hallucinogens:

psychoactive substances that alter sensory processing in the brain, producing visual or auditory sensations that are not real (i.e., that are hallucinatory)

phencyclidine (PCP):

drug that, depending on the route of administration and dose, can be a stimulant, depressant, or hallucinogen; originally

developed as an animal anesthetic

inhalants:

vaporous substances that, when inhaled, produce alcohol-like intoxication

anabolic steroids:

synthetic derivatives of the male hormone testosterone.



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CHAPTER 14

Common Psychoactive Drugs: Alcohol, Tobacco, Marijuana, and Caffeine



Health Tips

Are You a Problem Drinker?

Signs of Alcohol Overdose or Poisoning



Dollars & Health Sense

Marketing Alcohol to Youth



Wellness Guide

One Student's DUI Experience

Self-Care: Forgiveness

LEARNING OBJECTIVES

1. Explain percent alcohol content in beer, wine, and mixed drinks.
2. Define and explain blood alcohol concentration (BAC).
3. Describe alcohol use disorder (AUD) and the stages of alcoholism.
4. Describe how a family member's AUD affects the rest of the family.
5. List six health risks from smoking cigarettes.
6. Define and give examples of nicotine-delivery systems.
7. Define nicotine-replacement therapy.
8. Define THC and describe its physical and mental effects.
9. Identify the health effects of caffeine.

Among North Americans, alcohol, tobacco, marijuana (cannabis), and caffeine are the most used nonmedically prescribed drugs. Besides their effects on mood and consciousness, these drugs are commonly used by many people because they are legal (marijuana increasingly so), widely distributed, and affordable, and they have a long history of use among humans. Moreover, because these substances are potentially habit forming, it can be difficult for people to cut back or stop using them. About 60% of Americans drink alcohol every month, 15% smoke tobacco nearly every day, 35% use marijuana once or twice a month, and 90% ingest caffeine every day.

Alcohol

Humans have been consuming alcohol for thousands of years, probably ever since someone noticed a change in feelings and behavior from drinking some berry juice that had been left longer than usual in an earthen jar. Through the ages, drinking fermented grains (beer); fermented berries, grapes, and fruits (wine); and the distilled products of natural fermentation (so-called hard liquors) has been commonplace in many human societies. Alcohol is used in some religious ceremonies; taken as medicine; used to seal contracts, agreements, and treaties; and offered to display hospitality. Alcohol consumption has been an integral part of American life since the landing of the *Mayflower* at Plymouth Rock. Even so, many people regard drinking as a social evil and drunkenness as a sin. The U.S. government tried to legislate alcohol consumption out of American lives in 1919 with the Volstead Act, the effective legislation that enacted the 19th Amendment and prohibited the sale and consumption of alcoholic beverages (*Prohibition*). This attempt to control alcohol consumption failed, however, and Prohibition was repealed by another amendment to the Constitution in 1933.

O God, that men should put an enemy into their mouths to steal away their brains! That we should with joy, pleasure, revel, and applause, transform ourselves into beasts.

—Shakespeare, Twelfth Night

Approximately 75% of North American adults have at least one drink per year. About 55% drink at least once a month. Most regular consumers of alcohol engage in **moderate drinking**, which is men having and average or two or fewer drinks per day (14 drinks per

week) and women averaging no more than one drink per day (7 drinks per week). Other drinking patterns include the following:

- Of those 18 years of age or older, about 30% of men and 22% of women engaged in binge drinking at least once a month. Typically, **binge drinking** is a man consuming five or more, and a woman consuming four or more, drinks in about two hours. This degree of drinking generally brings the **blood alcohol concentration (BAC)** to 0.08 grams per deciliter of blood or higher, the legal limit for *driving under the influence* (DUI) in most jurisdictions.
- Among those 18 year of age and older, approximately 8% of men and 5% of women engaged in heavy alcohol use in the prior month. **Heavy alcohol use** is binge drinking on 5 or more days in the past month. About 2% of people ages 12–17 engaged in heavy alcohol use in the prior month.
- **High-intensity drinking** is two to three times the consumption of the gender-specific thresholds for binge drinking (10 or more drinks for males and eight or more for females) in a 2-hour period.
- About 9 million American men and 6 million American women aged 18 and older have an **alcohol use disorder**, a pattern of uncontrolled alcohol use that is socially and personally harmful.

Alcohol use and abuse are among the most significant health-related issues in the United States and many other countries. According to the National Institute on Alcohol Abuse and Alcoholism (2021a), in the United States, misuse of alcohol is responsible for nearly 95,000 deaths a year, shortening the lives of those who died by an average of 30 years, and accounting for 10% of deaths among

working-age adults aged 20 to 64 years. Each year worldwide, alcohol is responsible for 3 million deaths, accounting for about 6% of total global deaths (World Health Organization, 2018). Although they receive much more attention from governments and the news media, drugs other than alcohol cause far fewer health problems than alcohol does (**Figure 14.1**).

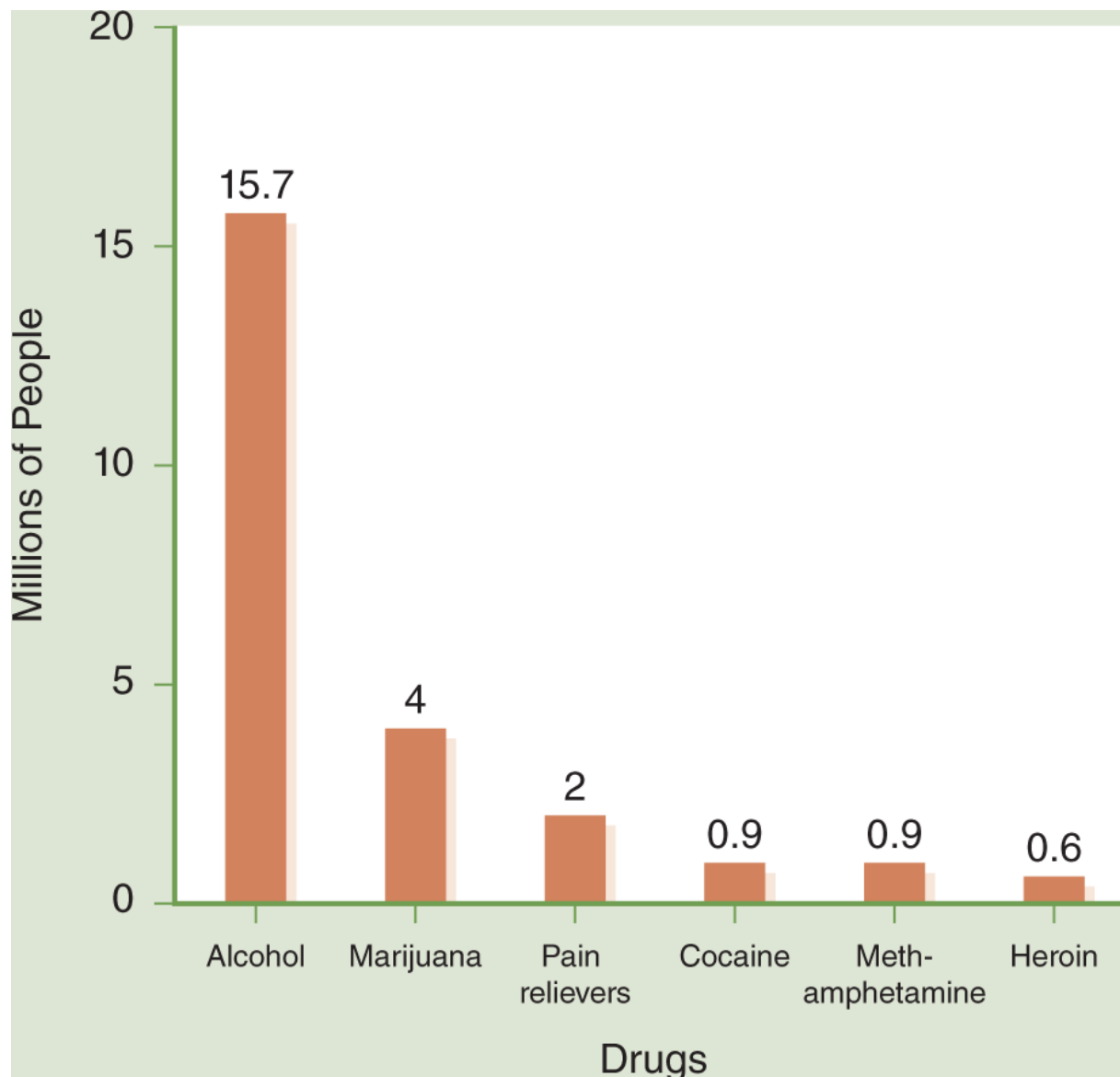


Figure 14.1 Number of Americans Older than 12 with Substance Abuse Disorders.

Data are for civilian, noninstitutionalized Americans over age 12. Values may include people who have use disorders for more than one substance.

Data from Substance Abuse and Mental Health Services Administration (2020). *Key substance use and mental health indicators in the United States: Results from the 2019 National Survey on Drug Use and Health* (HHS Publication No. PEP20-07-01-001, NSDUH Series H-55). Rockville, MD: Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration. Retrieved from <https://www.samhsa.gov/data/>.

Description

Excessive alcohol use is associated with thousands of divorces, as many as 80% of the incidents of family violence, 40% of crimes, and millions of hours of school and job absenteeism. Yearly, about 120 million Americans admit to alcohol-impaired driving, about 1 million are arrested for driving while intoxicated, and nearly 11,000 die from alcohol-related traffic collisions, accounting for 31% of all driving fatalities (Centers for Disease Control and Prevention, 2020a). Excessive alcohol consumption costs the U.S. economy about \$280 billion per year, or \$2 per drink. In addition, alcohol abuse is linked to a long list of medical problems (Molina et al., 2014).



Are You a Problem Drinker?

The CAGE questionnaire is a diagnostic tool for alcohol problems.

C = Concern by the person that there is a problem

A = Apparent to others that there is a problem

G = Grave consequences

E = Evidence of dependence or tolerance

Answer these questions:

1. Have you ever felt that you should Cut down on your drinking?
2. Have you ever become Annoyed by criticism of your drinking?
3. Have you ever felt Guilty about your drinking?
4. Have you ever had a morning Eye opener to get rid of a hangover?

One "yes" response indicates possible alcohol abuse.

Drinking on Campus

About 80% of North American college students drink alcohol at least once in awhile (American College Health Association, 2020). About 53% have consumed alcohol within the prior 2 weeks, and 60% within the past month. The vast majority of these students drink about once a week. About 50% of males and 75% of females report having had four or fewer drinks the last time they drank alcohol in a social setting. Others binge. About 18% of males and 16% of females had five or six drinks the last time they drank alcohol in a social setting; 23% of males and 8% of females had seven or more drinks the last time they drank alcohol in a social setting.

College students who regularly drink to excess are more likely:

- to miss class;
- to get behind in schoolwork;
- to do something they regret;
- not to protect against unintended pregnancy when engaging in sex;
- to engage in unplanned sexual activity;
- to get into trouble with campus police;
- to damage property;
- to get injured;
- to engage in dangerous driving behaviors;
- to disturb, insult, quarrel with, or assault others; and
- to require care from others while being sick from drunkenness.

The behaviors of excessive drinkers can affect moderate drinkers and alcohol abstainers. So-called **secondhand binge effects** include the following:

- being interrupted while studying,
- being awakened at night,
- having to take care of a drunken fellow student,
- being insulted or humiliated by a drunken student,
- being pushed, hit, or assaulted by a drunken student, and
- being the victim of sexual assault.

To reduce the degree of excessive drinking among students, leaders on college campuses are making efforts to change the campus culture regarding alcohol use. For example, irresponsible drinking is not viewed as a rite of membership in campus organizations (e.g., clubs, athletic teams, fraternities, sororities), as an acceptable way to lessen social anxiety in party or other social situations, as the definition of partying, as an acceptable means to deal with academic stress, or as a rite of passage to adulthood and independence from parental control.

How Alcohol Affects the Body

Composition of Alcoholic Beverages

The alcohol in beverages is a chemical called **ethyl alcohol (ethanol)**. There are many other kinds of alcohol, such as methyl alcohol and isopropyl alcohol. Most alcohols are poisonous if ingested even in small amounts. In large amounts, even ethanol is toxic, but the body has ways to detoxify and eliminate it given enough time.

The amount of ethanol in a commercial alcoholic product usually is listed on the product label (sometimes not beer). The amount of alcohol in beer and wine is usually given as the percentage of the total volume—*alcohol by volume* (ABV). Beer, for example, is generally about 4% alcohol, although some beers contain more or less. So-called light (“lite”) beers have nearly the same alcohol content as regular beers; “Lite” is a reference to fewer calories and regular beer and not less alcohol. Wine is about 12% alcohol. Hard seltzers generally are 5% AVB. The amount of alcohol in distilled or *hard liquors* (e.g., scotch, vodka, bourbon, tequila, rum) is given in terms of **proof**, a number that represents twice the percentage of alcohol in the product. Thus, an 80-proof whiskey is 40% alcohol; 100-proof vodka is 50% alcohol.



Signs of Alcohol Overdose or Poisoning

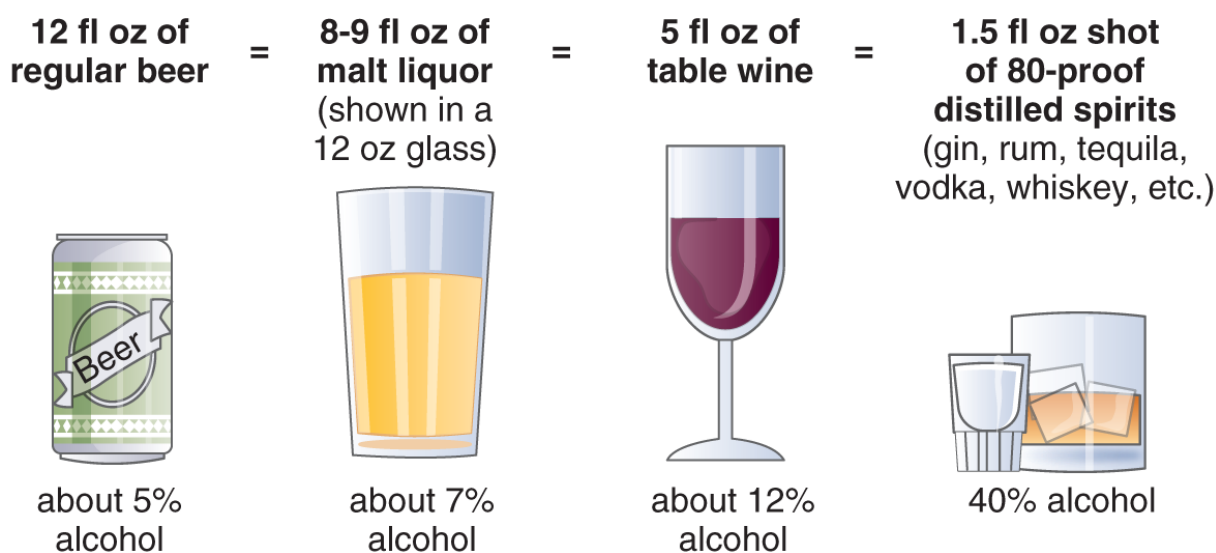
No one expects to die from partying, but it can happen. Alcohol is a potent central nervous system depressant, and too much of it can inhibit the brain's breathing center, leading to irreversible brain damage or death. Also, alcohol can inhibit the gag reflex, causing death by aspiration of vomit into the lungs. Even if someone has passed out from ingesting too much alcohol, alcohol in the intestines continues to be absorbed into the body, increasing the risk of death. Don't assume an intoxicated person will be fine by sleeping it off. Know the signs of alcohol poisoning:

- confusion, stupor, coma, or the person cannot be roused;
- vomiting;
- seizures;
- slow breathing (fewer than eight breaths per minute);
- irregular breathing (10 seconds or more between breaths); and
- low body temperature, bluish skin color, paleness.

If you suspect alcohol poisoning, don't try to sober the person up with black coffee, a cold bath or shower, or walking it off. Those methods don't work. Call 911 right away. You don't want to feel responsible for an alcohol-related tragedy. And don't worry that your friend may become angry or embarrassed afterward. Remember: You cared and did the right thing.

National Institute on Alcohol Abuse and Alcoholism. (2021). College Drinking"Changing the Culture. Facts about alcohol poisoning. Retrieved from <http://www.collegedrinkingprevention.gov/parentsandstudents/students/factsheets/factsaboutalcoholpoisoning.aspx>.

Most standard portions of alcoholic drinks contain about the same amount of alcohol (**Figure 14.2**). For example, a 12-ounce beer that is 5% alcohol contains 0.6 ounces of alcohol. The same amount of alcohol is in a 5-ounce glass of wine that is 12% ABV. The alcohol content of a mixed drink made of 1.5 ounces of 80-proof spirits (40% alcohol) contains 0.6 ounces of alcohol. So, a can of beer, a 12-ounce can of hard seltzer, a glass of wine, and a mixed drink contain approximately the same amount of alcohol. Thus, the perception that a beer is less alcoholic than a glass of wine or a mixed drink is wrong. Note that some malt liquors and ales are 6% to 8% alcohol, fortified wines such as sherry and port are 18% alcohol, and some distilled liquors are 100 proof (50% alcohol).



The percent of “pure” alcohol, expressed here as alcohol by volume (alc/vol), varies by beverage.

Figure 14.2 Alcohol Content of Various Liquors. A 12-ounce serving of regular beer, a 9-ounce serving of a regular malt liquor, a glass of wine, and a mixed drink have about the same amount of alcohol. Don’t be fooled by the type of drink.

National Institute of Alcohol Abuse and Alcoholism, “What is a Standard Drink?”. Retrieved from <https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/what-standard-drink>.

Description

How Alcohol Is Absorbed, Excreted, and Metabolized

After alcohol is ingested, it is readily absorbed into the stomach and the small intestine. The alcohol is then carried through the bloodstream to all the body’s tissues and organs. Although not strictly a food (it contains no protein, vitamins, or minerals), alcohol does contain calories—in fact, 7 calories per gram (almost twice as many calories per gram as sugar). A regular serving of beer, wine, hard seltzer, or a mixed drink has between 100 and 150 calories.

Several factors affect the rate at which alcohol is absorbed into body tissues. For example, food in the stomach—especially fatty foods or proteins—slows the absorption of alcohol. Nonalcoholic substances in beer, wine, and cocktails can also slow absorption of alcohol. The presence of carbon dioxide in beverages such as

champagne, sparkling wines, beer, and carbonated mixed drinks increases the rate of alcohol absorption. That is why people feel intoxicated more quickly when drinking champagne or beer, especially on an empty stomach. The higher the alcohol content in a drink, the faster it is absorbed.

The concentration of alcohol in the blood is called the *blood alcohol content* (BAC), which is measured in grams of alcohol per deciliter of blood. A simple way to estimate BAC is to assume that ingesting one standard drink per hour (one beer, one glass of wine, one mixed drink) that contains approximately one-half ounce of ethyl alcohol produces a BAC of 0.02 in a 150-pound male. Thus, the BAC of an average-sized man who drinks five beers during the first hour at a party will be 0.10; this level of alcohol in the blood violates most drinking-and-driving laws. This shorthand method of approximating BAC depends on a person's body size, body composition (e.g., relative amounts of body muscle and fat), and sex. All other things being equal, after ingesting the same amount of alcohol, the BAC of a large person is less than that of a smaller person because the alcohol is diluted more in the large person's tissues. Women tend to have a higher BAC from the same number of drinks as men do because they generally weigh less than men, have proportionately more body fat (which does not absorb alcohol as readily as muscle and other tissues), have sex hormones that tend to increase alcohol absorption and decrease its elimination, and tend to absorb more alcohol from the stomach.

Alcohol is eliminated from the body in two ways. About 10% is excreted unchanged through sweat, urine, or breath (hence the use of breath analyzers to test for drinking). The portion of alcohol that is not excreted (about 90%) is broken down primarily by the liver (metabolized), ultimately winding up as carbon dioxide and water. The liver detoxifies alcohol at a rate of about one-half ounce (one drink) per hour; there is no way to speed up the process. Sobering-up remedies such as drinking a lot of coffee, taking a cold shower, or engaging in vigorous exercise do not accelerate the rate at which the liver removes alcohol from the body.

The Hangover

An occasional consequence of drinking too much alcohol is a **hangover**, which may involve stomach upset, headache, fatigue, weakness, shakiness, irritability, and sometimes vomiting. The frequency and severity of hangovers vary. Factors that cause a hangover are the following:

- When alcohol is present in the body, normal liver functions may slow to break down the alcohol. This slowdown may reduce the amount of sugar the liver releases into the blood, resulting in temporary hypoglycemia and its resultant fatigue, irritability, and headache.
- Alcohol may inhibit rapid-eye movement sleep, resulting in fatigue, irritability, and trouble concentrating.
- *Congeners*—nonalcohol chemical substances in an alcoholic beverage—or breakdown products produced in the liver may cause a hangover.
- *Acetaldehyde*, a toxic substance produced when the liver breaks down alcohol, may be responsible for hangover symptoms.

The best way to deal with a hangover is to sleep, drink juice to replace lost blood sugar and lost body fluid (alcohol increases urine output), and perhaps take an analgesic for a headache. Ingesting more alcohol will only prolong the hangover symptoms.



Marketing Alcohol to Youth

Alcohol use is a major health issue among youth. Several thousand middle and high school students report getting drunk every day. Between 20% and 25% of high schoolers

report consuming five drinks in a row during the prior 2 weeks. Alcohol use is responsible for about 5,000 deaths per year among persons younger than 21. Americans spend about \$280 billion on alcohol each year; underage drinking accounts for about \$40 billion of alcohol sales.

To help curtail alcohol use by youth, the Institute of Medicine, a division of the National Academy of Sciences, and Congress's Sober Truth on Preventing Underage Drinking Act want to reduce exposure of youth to alcoholic beverages and alcohol advertising and marketing directed at them.

Each year, youth (ages 12–20) are exposed to billions of alcohol advertisements on TV, radio, and the Internet and in magazines; brand naming in popular music; and product placements in films for youth audiences. About 40% of TV alcohol ads are placed on cable TV shows with a large youth audience. The U.S. Surgeon General and a variety of youth health advocates want alcohol companies not to advertise in programming in which youth represent more than 15% of the audience.

Although the alcohol industry has voluntarily agreed not to advertise its products when 12- to 20-year-olds make up more than 28.4% of the audience, research shows that about 11% of alcohol advertising is placed when the audience is greater than 30% youth (Ross et al., 2020). Beverage companies that claim they are not contributing to the underage drinking problem and helping to develop a new generation of alcoholics are doing just what the cigarette companies did for decades—denying everything as long as the product is legal and profitable.

The Effects of Alcohol on Behavior

Pharmacologically, alcohol acts as a central nervous system depressant, which means that it slows certain functions in some parts of the brain. In moderate amounts, alcohol may affect the parts of the brain that control judgment and inhibitions, which is why many people have a drink or two at a party to help “loosen up” or to become less shy and more able to interact freely with others. Although some people may talk or laugh more than usual, others may become boisterous, argumentative, irritable, or depressed.

The behavioral effects of alcohol depend on the BAC (**Table 14.1**). At a BAC of 0.02, the “loosening-up” effects of alcohol manifest. At a BAC of 0.10, the depressant effects of the drug become pronounced, the person may become sleepy, and motor coordination is affected. Speech may become slurred and postural instability may become noticeable.

TABLE 14.1 | Behavioral Effects of Alcohol in a 150-Pound (68-Kg) Male

Number of Drinks	Ounces of Alcohol	BAC* (g/dl)	Approximate Time for Removal	Effects
1 beer, 1 glass of wine, or 1 mixed drink	½	0.02	1 hour	Feeling relaxed or “loosened up”
2½ beers, 2½ glasses of wine, or 2½ mixed drinks	1¼	0.05	2½ hours	Feeling “high”; decrease in inhibitions; increase in confidence; judgment impaired
5 beers, 5 glasses of wine, or 5 mixed drinks	2½	0.10	5 hours	Memory impaired; muscular coordination reduced; slurred speech; euphoric or sad feelings
10 beers, 10 glasses of wine, or 10 mixed drinks	5	0.20	10 hours	Slowed reflexes; erratic changes in feelings
15 beers, 15 glasses of wine, or 15 mixed drinks	7½	0.30	15–16 hours	Stuporous, complete loss of coordination; little sensation
20 beers, 20 glasses of wine, or 20 mixed drinks	10	0.40	20 hours	May become comatose; breathing may cease
25–30 beers, 25–30 glasses of wine, or 25–30 mixed drinks	15–20	0.50	26 hours	Fatal amount for most people

*BAC, blood alcohol content

Description

Alcohol’s effects on motor skills, judgment, and reaction times make driving after drinking extremely dangerous. Even after just one or two drinks, although an individual may not be legally drunk, reaction time, perception, and judgment are impaired. Approximately 32% of the nearly 34,000 highway fatalities each year involve people who are intoxicated. Highway accidents are among the leading causes of death in the United States. The American College Health Association reports that about 12% of American college students drive after ingesting alcohol (American College Health Association, 2020).

Each year there are more than 120 million self-reported episodes of alcohol-impaired driving in the United States. Men in the 21 to 24 age group have the highest frequency of alcohol-impaired driving; men in the 25 to 34 age group have the second-highest frequency. By contrast, the rate of alcohol-impaired driving among women in the

same age groups is one-fourth that of their male peers. The frequency of alcohol-impaired driving declines in late middle-age.

Besides impaired driving, alcohol consumption contributes to arguments, fights, jeopardized relationships, employee absenteeism, school failure, and lost jobs. Alcohol is linked to anger and violence in several ways. Alcohol blunts self-control and other brain functions, thus enabling impulsive outbursts of anger and violence toward others and oneself and inattention to potentially violent social situations. Neurobiological dependence on alcohol can lead to failing to fulfill commitments and responsibilities to sustain oneself and one's family. Most homicides, assaults, robberies, sexual offenses, and incidents of domestic violence are alcohol related.



One Student's DUI Experience

Early in the morning last summer, I was arrested for driving under the influence of alcohol (DUI).

It's not easy to recall what actually happened—I see it through a fog, as if I am watching someone else.

The actual arrest is the blurriest. I was running for those few moments on pure adrenalin and fear. For awhile, I don't even think I was breathing.

It's hard to explain the exact emotions.

It's hard to explain what it feels like to want more than anything to be sober.

It's hard to explain losing complete control of your life for even a short time.

It is hard to explain the feeling of handcuffs.

It's hard to explain what it feels like to sit in a holding cell and bite your lip in the hope of not going to sleep.

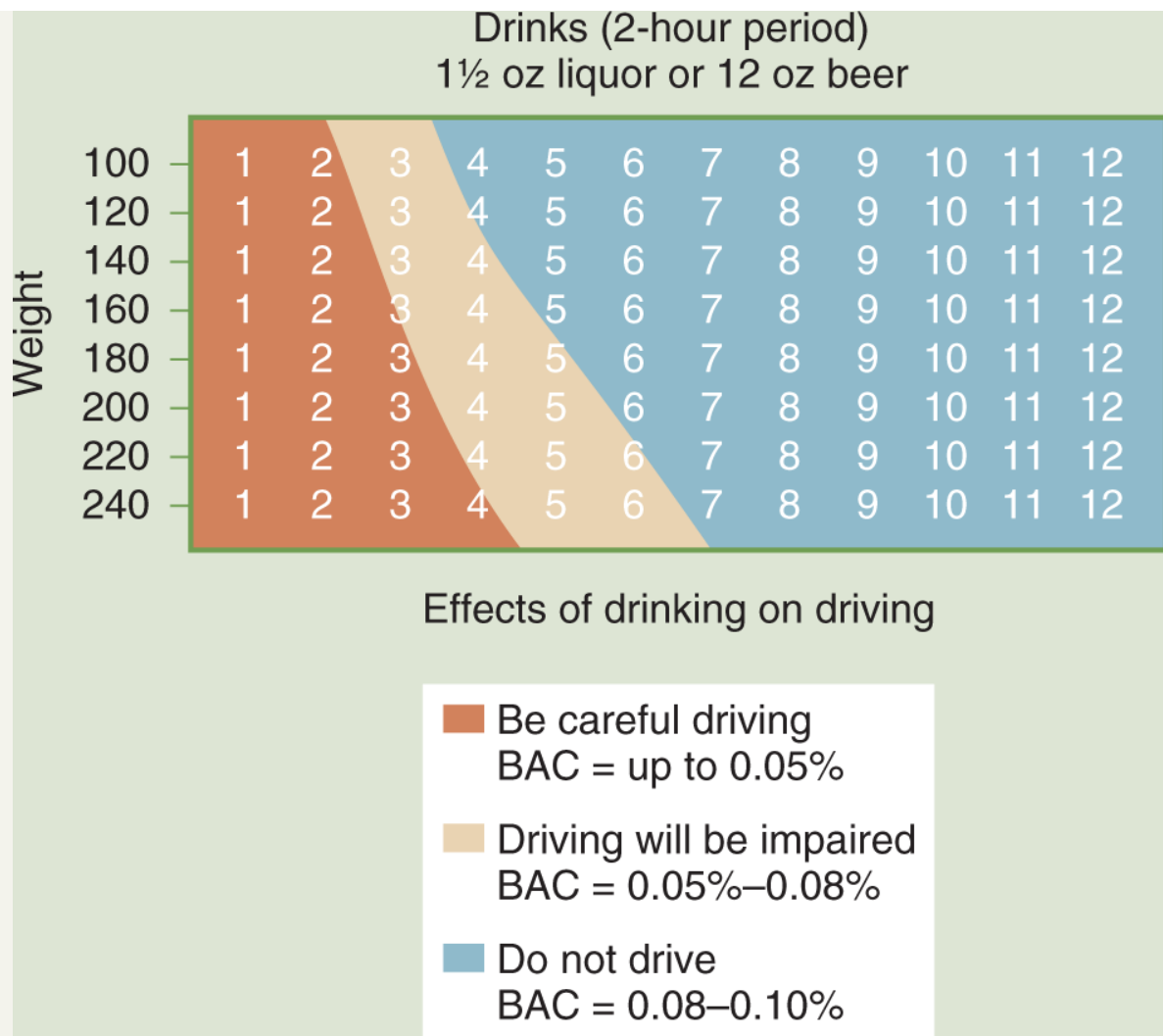


Chart: Data from The California Highway Patrol Blood Alcohol Concentration Chart.

Description

One thing for sure is that when those flashing lights appeared in my rearview mirror, all the rationalizations that got me into that car vanished. “It’s just around the corner,” “I need to get a friend home,” or “No one is on the road at this hour”—none of them mean a thing—zero.

At the jail, it took what seemed like days to be fingerprinted and photographed and to fill out the required forms. Each step was just a little more humiliating than the last.

I am still overwhelmed at how a single, incredibly poor judgment could affect so many parts of my life.

The ramifications will be with me in various ways for the next 3 years—which is as far ahead as I have ever cared to plan.

These shock waves include probation for 3 years, an exorbitant increase in the cost of my car insurance, a restricted driver’s license for 90 days (which was agreed upon in lieu of 2 days in jail), and a \$600 fine, to name a few.

Many of the ramifications cannot be quantified. There was the call home, a couple of days of generally feeling lousy, and the unshakable sense that I had proven myself a fool.

Through all of it, however, I have some things to be thankful for.

On the top of that very short list is the fact that I didn't kill anyone.

Having struggled to come to terms with the arrest, it is impossible to imagine . . . for that there is no atonement.

Also on that list is the discovery of some very supportive people in my life, all of whom said not that what happened was okay, but that I was going to be okay. I turned to my parents and friends for help, and no one turned away—I am thankful.

Whether this column will keep anyone from driving drunk is doubtful. If I had read this column before my arrest, I would have thought of a hundred reasons why it would never have applied to me—but I would have been wrong.

Reproduced from The California Aggie (April 10, 1990). University of California, Davis.

Sexual Behavior

The effects of alcohol on sexual desire and performance vary from person to person and depend on the BAC. In some individuals, small amounts of alcohol may dispel uncomfortable feelings about sex and may facilitate sexual arousal. Higher amounts of alcohol (a BAC of 0.10 or more) may cause problems for males such as difficulty getting and maintaining an erection or ejaculating; females may experience inadequate vaginal lubrication and difficulty achieving orgasm. Even at moderate BACs, some individuals are too intoxicated to give and receive sexual pleasure.

Alcohol consumption may contribute to a variety of undesired consequences of sexual behavior. While intoxicated, people can forget to use pregnancy prevention correctly or simply ignore the practice altogether and thus become unintentionally pregnant. Not using condoms or having sex with a stranger increases the risk of transmission of sexually transmitted diseases. Alcohol can blur one's judgment and can lead to unintended sexual experiences such as sexual assault.

Other Effects of Alcohol

Alcohol can impair the functioning of body organs other than the brain. Alcohol can irritate the organs of the gastrointestinal tract—the esophagus, stomach, intestine, pancreas, and liver—causing upset or irritation, nausea, vomiting, or diarrhea. Alcohol can also dilate arteries and cause bloodshot eyes. Dilation of arteries in the arms, legs, and skin can cause a drop in blood pressure and decrease body heat, explaining why people occasionally feel flushed when they drink. Giving alcohol to people to “warm them up” actually produces the opposite physiological effect.

Alcohol should not be ingested simultaneously with other central nervous system depressants such as tranquilizers, sedatives, and antihistamines, which are found in cold medicines. In many instances, the depressant effects of alcohol and the other drug interact so that the combined effects of the two drugs are greater than the simple additive effects of either drug taken separately. Seemingly reasonable amounts of alcohol taken with another depressant drug can dangerously suppress brain function and respiration ([Table 14.2](#)).

TABLE 14.2 Alcohol and Drugs That Don’t Mix	
Alcohol should not be consumed when taking drugs such as these.	
Drug	Dangerous Interaction
Allergy, cold, or flu or cough medicine containing loratadine (Claritin), diphenhydramine (Benadryl), chlorpheniramine (Tylenol Allergy Plus), or dextromethorphan (Robitussin)	Drowsiness, possible overdose
Anxiety or epilepsy medicine containing lorazepam (Ativan), alprazolam (Xanax), paroxetine (Paxil), phenytoin (Dilantin),	Drowsiness, breathing

clonazepam (Klonopin), or phenobarbital	problems, overdose
Pain or arthritis pain medicine containing ibuprofen (Advil, Motrin), aspirin, acetaminophen (Tylenol), oxycodone (Percocet), or hydrocodone (Vicodin)	Ulcers, stomach bleeding, liver damage
Medicine for sleep problems such as zolpidem (Ambien), eszopiclone (Lunesta), or diphenhydramine (Sominex)	Drowsiness, impaired breathing, overdose

For more information, see National Institute on Alcohol Abuse and Alcoholism. (2014). Harmful interactions. <http://pubs.niaaa.nih.gov/publications/medicine/medicine.htm>

Long-Term Effects

Long-term heavy drinking can affect immune, hormone, and reproductive functions and cause neurological problems, including dementia, blackouts, seizures, hallucinations, and bodywide nerve damage. Various cancers associated with heavy drinking include cancers of the lip, oral cavity, pharynx, larynx, esophagus, stomach, colon, rectum, tongue, lung, pancreas, and liver. Long-term heavy drinking can also increase the risk of chronic gastritis, hepatitis, hypertension, cirrhosis of the liver, and coronary heart disease.

Chronic alcoholic men may become “feminized,” with breast enlargement and female body hair patterns. Chronic alcoholic women may experience menstrual disturbances, loss of secondary sex characteristics, and infertility. Women who drink heavily experience more gynecological problems and have surgery more often than women who do not.

Possible Health Benefits of Alcohol

Many studies have shown an association between regular consumption of small amounts of alcohol (about one drink per day) and a reduced risk of death from heart disease (Le Daré et al., 2019). Greater alcohol consumption, on the other hand, is

associated with a greater risk of death from heart disease. Small amounts of alcohol consumption also seem to protect against type 2 diabetes, autoimmune disease, and neurodegenerative diseases such as Alzheimer's disease. The benefits of alcohol consumption were first reported among people in France, where it was noted that despite a diet high in fat, the rate of heart disease is low. This anomaly became known as the *French Paradox*. The explanation for the French Paradox is the presence in red wine of substances called *flavonoids*, which are heart healthy. Other alcoholic beverages also are heart healthy, but the reasons for that are not clear. Although not discounting possible healthful biological effects of chemical substances in alcoholic beverages, and possibly alcohol itself, researchers also note that a drink with the evening meal can dampen the stress of a busy day, and that social interactions with family and friends—with a drink or not—can be relaxing and joyful and therefore contribute to health.

Alcohol Use Disorder

Alcohol use disorder is characterized by alcohol-related impairment or distress or neurobiological dependence (addiction) on alcohol (or both). AUD can be mild, moderate, or severe, depending on the degree of impairment and neurobiological dependence.

Alcoholism, the most severe form of AUD, is characterized by an intense craving for alcohol, compulsive drinking behavior, an inability to control one's drinking, and physical dependence on alcohol. Withdrawal symptoms, including anxiety and stress, and **delirium tremens (DTs)**. DTs is characterized by hallucinations and uncontrollable shaking and may occur when a person affected by alcoholism is deprived of alcohol.

The Stages of Alcoholism

A large body of research suggests that alcoholism develops in four stages. Stage 1 is psychological attachment to alcohol. Most people consume alcohol to accompany other experiences, like having wine to enhance a meal or enjoying a beer at a ball game. Because alcohol can lessen anxiety and facilitate “feeling good,” some people become attracted to creating this alcohol-induced state of mind; over time, they increase their intake of alcohol, not as an adjunct to other experiences, but to create the alcohol-induced drug experience itself. With regular ingestion of alcohol, the brain adjusts to the frequent, if not continual, presence of alcohol such that increasing amounts of alcohol are needed to produce the expected, desired effects. This is **tolerance**. If drinking continues, eventually the original mental rewards of drinking become overshadowed by the unpleasant experience of not drinking, even for a short period of time. This unpleasant mental and bodily state is called **withdrawal**. The process eventually culminates in intense craving for alcohol and a lifestyle devoted to satisfying it.

In the second stage of alcoholism, tolerance for alcohol increases and individuals become more preoccupied with drinking. For example, when invited to a party they may ask what alcoholic beverages will be served rather than who is going to be there. In this stage, problem drinkers may sneak drinks often and may deny that they are drinking too much. **Blackouts** may also occur. Blackouts are periods in which others observe the drinker as behaving normally or abnormally, but the drinker has no recall of events that happened while drinking.

The third stage of alcoholism is characterized by loss of control over how much alcohol is consumed. The person may not drink every day but cannot control the amount of alcohol consumed once drinking has begun. In this stage, the problem drinker may rationalize drinking behavior and actually believe that there are good reasons for heavy drinking. The person may still carry out responsibilities (e.g., housework, job, schoolwork) for some time and may employ a series of strategies to prevent family rejection, including promises to stop drinking. Often alcoholics' extravagant measures to prove they do not have a drinking problem appear successful, but eventually they begin drinking heavily again. At this point, the problem with alcohol is sometimes blamed on the kind of drinks preferred or on the usual place of drinking; as a result, problem drinkers may change to a different form of alcoholic beverage or to a different place in which to drink.

In the fourth stage, the alcoholic is dependent on the drug, and drinking behavior consumes nearly all aspects of life. Friends and family have resigned themselves to the problem and may be angry or ignore the alcoholic. At this stage of alcoholism, the person may miss work or school occasionally. The health consequences of alcohol abuse may intensify, and the person may need medical attention and even hospitalization. When physical addiction to alcohol occurs, continual drinking is needed to prevent withdrawal symptoms. Drinking for days at a time (a **bender**) may take place. The great majority of alcoholics do not wind up on "skid row" but instead struggle with their problem within their families and communities.

Treatment Options for AUD

The situation of problem drinkers and alcoholics is serious but not hopeless. Recovery is possible if the person is strongly motivated to stop drinking and address motivations for using alcohol.

Sometimes the motivation to stop drinking comes in the form of a threat—a drinking-related legal problem or illness, severe disruption of family life, the loss of a job. The motivation to stop drinking can also come from the person's own resolve to stop his or her self-destructive behavior and to stop feeling helpless, hopeless, and confused.

Alcoholics Anonymous (AA), the worldwide nonprofit self-help organization, has assisted many people to get on the road back to wellness and enjoyment of life. AA bases its program on total sobriety, anonymity, and a step-by-step program of recovery. The environment at AA meetings is relaxing, caring, and open. Members share their experiences, strengths, and hopes with each other, with the goal of helping new and old members identify and learn more about their own problems with alcohol. Practical tips on how to remain sober are shared, and telephone numbers are exchanged so that a member can contact another member if stressful situations arise that historically led to drinking.

Alcoholics Anonymous emphasizes that sobriety is a state of mind, which means that recovering from a drinking problem involves changing values, attitudes, and lifestyles. The AA program helps problem drinkers honestly examine their feelings, recognize their limitations, and accept responsibility for past wrongs. For problem drinkers, remaining sober is an ongoing process, which involves finding new ways to satisfy emotional, spiritual, and social needs.

Besides AA, problem drinkers can receive help from individual and group psychotherapy. Many therapists are trained specifically to help problem drinkers and their families recover. Also, certain medicines may help. Disulfuram (Antabuse) causes uncomfortable physical and mental feelings when alcohol is ingested. Naltrexone can help reduce the craving for alcohol. Acamprosate reduces withdrawal symptoms.

Alcohol Use Disorder and the Family

Alcohol use disorder can severely stress a family, causing nondrinking family members mental and emotional suffering and sometimes financial hardship. About 50 million Americans, about 15% of the population, have been exposed to severe AUD in their family, including 9 million children under age 18.

Close relatives of a problem drinker can experience a variety of emotions, ranging from joy and relief when the problem drinker stops drinking for a time to depression and feelings of failure when the problem drinker begins drinking again. Family members can feel anger, shame, guilt, pity, and constant anxiety. Some try to cope by assuming responsibility for the problem; others may be designated scapegoats and blamed for the drinker's problem with alcohol. Some may withdraw in silence, whereas others try to maintain their sense of humor. These behaviors are all defenses against the family's psychological distress.

Like the problem drinker, family members may deny the problem, try to rationalize it, and isolate themselves from friends and relatives, and, in some cases, a family member may actually feel responsible for the drinker's problem. This **enabling**, or protection process, keeps the problem drinker from feeling responsible for his or her drinking—which is part of the paradox experienced by families of alcoholics. In their attempts to protect the alcoholic, family members may unwittingly contribute to the drinking problem; they may try to protect the alcoholic from serious social consequences of excessive drinking, for instance, making excuses for absenteeism from work or school.

Al-Anon is an organization that helps spouses, families, and friends of alcoholics. Alateen is a similar organization that helps children of alcoholics. Al-Anon and Alateen help family members understand how alcoholism has affected their lives and help them explore the family relationships that contribute to the alcohol problem. Family therapy (with or without the problem drinker's participation) may help a family find ways to cope with the problem and regain harmony in their family life.

Children of Alcoholics

Children growing up in families in which one or both parents have a drinking problem may experience neglect, emotional deprivation, abuse, an unstable family environment, and sometimes violence. As a result, they may have developed thought, emotion, and behavior patterns that impair their personal lives and relationships in adulthood. *Children of alcoholics*, often referred to as COAs, are at a high risk of becoming alcoholics themselves.

Many COAs learn as children to block from their awareness the truth of their situation—both the fact of a parent's alcoholism and also their emotional distress resulting from it. This tendency is referred to as **denial**. The consequences of denial can go beyond issues of parental alcoholism to become a generalized way of approaching life. As adults, many COAs are constricted in their capacities to see the world as it really is and to experience emotional fulfillment.

Many COAs have a negative self-image and a tendency to be hypercritical of themselves. As children, they believe themselves to be the cause of their parents' erratic and sometimes violent behavior. Indeed, sometimes the parents reinforce this assumption by blaming their children for their own alcohol-related problems. The children not only come to believe themselves to be “bad” but also tend to believe they are responsible for everyone else's emotions. They can become so focused on others that they have no lives of their own, a characteristic called **codependency**.

Another consequence of growing up in an alcoholic family is the tendency to try to control situations and other people. Because family life was unstable and painful, many COAs come to believe that their interpersonal environment is likely at any moment to become emotionally painful, violent, or disruptive. Thus, COAs tend to be constantly anxious and hypervigilant for signs of danger. To minimize the threat (experienced as criticism, abandonment, or abuse), COAs tend to be compliant and agreeable and actively try to please others. Believing that others cannot be trusted and that the

world must be made safe, COAs also try to be totally self-reliant and in control of their lives.



Self-Care: Forgiveness

If you've been hurt or harmed by someone, it makes sense to be bitter and perhaps hold a grudge. Bitterness and grudges are forms of anger intended to defend yourself from future hurt. Unfortunately, prolonged bitterness and grudges can be heavy psychological burdens capable of triggering biological stress reactions, which in the long run can be unhealthy. One antidote to carrying a grudge is forgiveness. This does not mean forgetting what happened or excusing inappropriate, hurtful behavior. Forgiveness is not about the other person: It's about you. You let go of and get past hurt and anger (as much as you are able to) so you do not hurt yourself with your own psychology. In other words, the reason to forgive is to give yourself peace of mind.

In 1949, the Chinese Communist government invaded and took over its neighbor, the Buddhist country of Tibet. Since that time, more than 1.2 million Tibetans (20% of the population) have been killed, more than 6,000 Buddhist monasteries have been destroyed, and thousands of Tibetans have been imprisoned. The Dalai Lama, the Tibetan political and spiritual leader, fled to India in 1959 with more than 100,000 other Tibetan refugees. On a trip to America, the Dalai Lama was asked by a journalist if he hated the Chinese for taking over his country and killing so many of his people. The Dalai Lama replied, "It is true that the Chinese have brutally taken so much goodness away from me. But if I hate them, I will give them my mind, too, and I will not do that." Rather than hate, the Dalai Lama revealed in a subsequent interview that he felt compassion and forgiveness for the Chinese authorities that they lacked the wisdom to see the cruelty of their behavior.

One forgiveness strategy is to "turn the other cheek" by accepting the transgressor's motives, behaviors, weaknesses, or lack of judgment in light of the past and any possible future relationship. An alternative forgiveness strategy is to focus on your own well-being by having compassion for yourself and empathy for the pain of your misfortune. Treat yourself as you would a dear friend who's suffering because of another's lack of consideration and kindness. This doesn't erase the transgressor's harmful behavior ("That's OK") ; it doesn't avoid the hurt you've experienced ("I just don't think about it."). Self-care focuses directly on the hurt and brings as much goodness as possible to relieve the pain and provide a path for moving on in life.

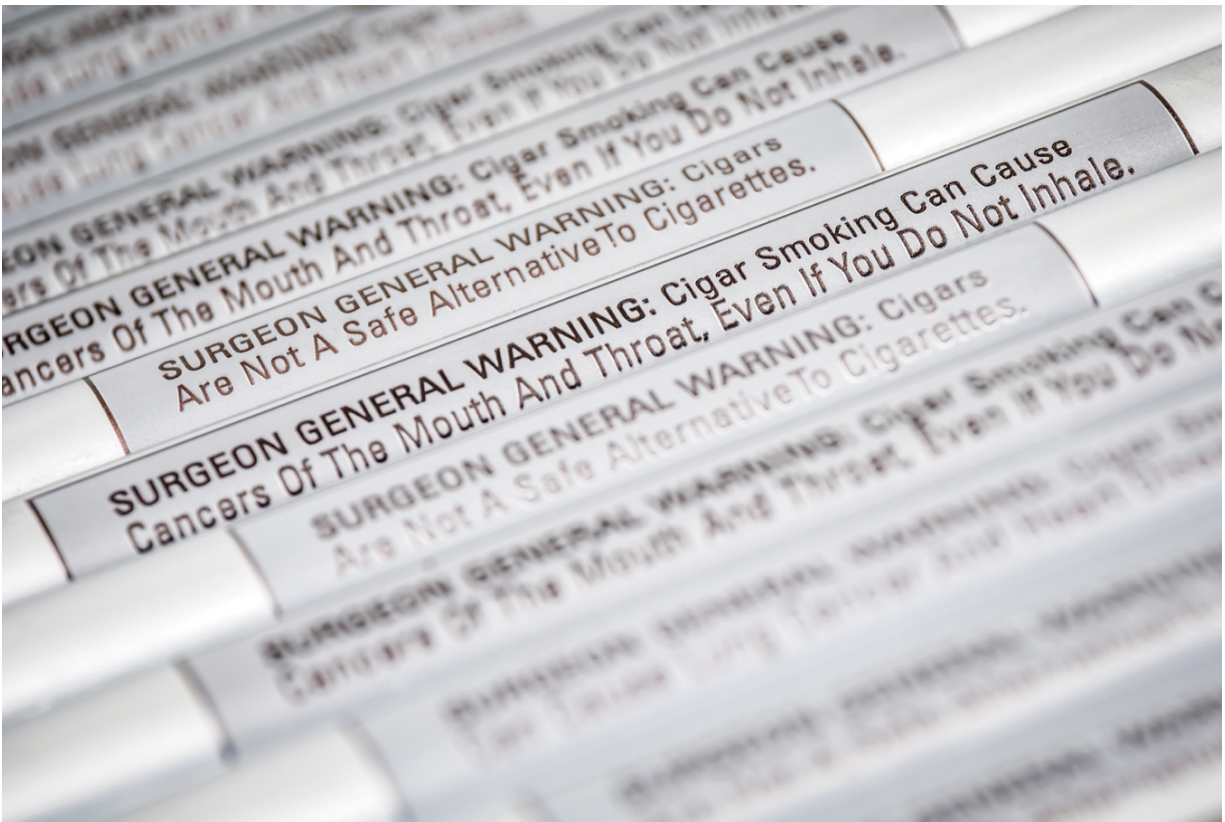
Studies show that forgiveness can lead to healthier relationships; greater spiritual and psychological well-being; less anxiety, stress, and hostility; lower blood pressure; fewer symptoms of depression; a stronger immune system; improved heart health; and higher self-esteem (Mayo Clinic, 2020).

Denial (not believing the truth), a negative self-image, the tendency to take responsibility for others, the need to control oneself and the environment, and other characteristics help a COA survive childhood in an alcoholic family. Unfortunately, in adulthood these same “survival” strategies limit the opportunity to grow and develop unique individual qualities and to experience healthy interpersonal relationships. Fortunately, these self-limiting beliefs and behaviors can be changed through awareness and professional help.

Tobacco and Other Nicotine-Delivery Systems

By now, just about every North American adult knows that smoking cigarettes is a ticket to a shorter life. This is the reason why the number of American adult smokers has been steadily declining—from about 40% in 1970 to about 14% now. About 9% of North American college students smoke cigarettes (American College Health Association, 2020).

Smoking kills more people than AIDS, car accidents, alcohol use, homicides, illegal drugs, suicides, and fires combined. It contributes substantially to deaths from cancer (especially cancers of the lung, esophagus, oral cavity, pancreas, kidney, and bladder), cardiovascular disease (i.e., coronary heart disease, stroke, and high blood pressure), lung disease (i.e., chronic obstructive pulmonary disease, cancer, and pneumonia), burns, and problems in infancy caused by low birth weight. Each year about 440,000 Americans die as a result of tobacco smoking, accounting for one in five deaths in the United States annually. Included in this total are approximately 1,300 children who die from in-home fires caused by adults smoking cigarettes. Worldwide, about 6 million people die from smoking each year. On average, smokers die about 10 years earlier than nonsmokers. Tobacco use is the single most preventable cause of death in the United States.



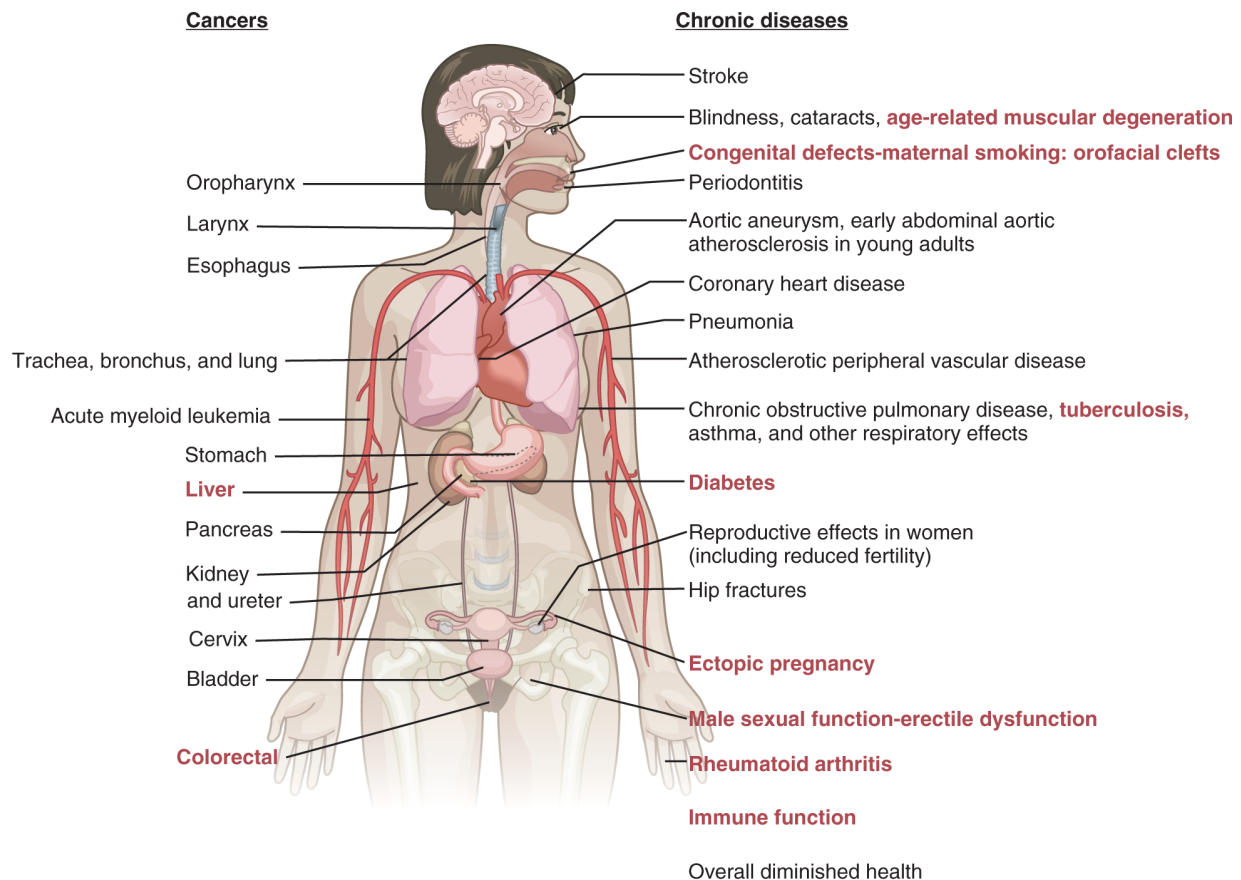
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The economic costs of smoking are staggering. Cigarette smoking costs the United States more than \$300 billion in healthcare costs and lost productivity annually. Only 17% of those costs are covered by smokers themselves in the form of cigarette taxes, direct costs, and health insurance. The remaining smoking-related costs are borne by nonsmokers. On average, each pack of cigarettes sold costs American society about \$4 in smoking-related health expenses.

Cigarettes are the only legal product that, when used as intended, cause death.

—**Louis W. Sullivan**, former secretary of U.S. Department of Health and Human Services

Most smokers risk the multitude of smoking-related health problems and early death (**Figure 14.3**), not because they like the smell, taste, and inconvenience of dealing with the burned shredded, dried leaves of the tobacco plant (*Nicotinia tabacum*)—and spending hundreds of dollars a year for the opportunity—but because they are addicted to **nicotine**, a potent nervous system stimulant in tobacco leaves, and rituals surrounding the smoking habit. When tobacco is burned, besides nicotine, more than 4,000 other chemicals are released in the smoke and carried into the smoker's body and the immediate surroundings (**secondhand smoke**). About 50 of these chemicals cause cancer; others cause chronic inflammation of the blood vessels, heart muscle, and other organs, increasing the risk of disease and death. Moreover, tobacco smoke contains microscopic particles that contribute to its yellowish-brown residue, known as **tar**, a documented cause of lung cancer.



Note: The condition in red is a new disease that has been causally linked to smoking in this report.

Figure 14.3 Health Effects of Tobacco Use.

U.S. Centers for Disease Control and Prevention (2020). Health effects of cigarette smoking.

https://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking/index.htm#health-risks.

Description

The majority of smokers would like to stop smoking, and each year many try. But nicotine is so addicting that only a small percentage successfully quit on their first try. Most smokers must make multiple attempts before they quit permanently. Stop-smoking programs, nicotine-replacement therapy with nicotine gum or nicotine skin patches, and medications to control nicotine-induced cravings can help.

That the death and destruction caused by smoking is from pollutants in tobacco smoke and not nicotine itself, consumers have turned to alternative nicotine-delivery systems as a safer way to experience nicotine's effects on the brain or as a treatment for withdrawal from nicotine addiction. Some of these cigarette alternatives still require burning tobacco (cigars, hookahs, bidis, kreteks). Chewing tobacco and snuff involve extracting nicotine from tobacco directly into body fluids without burning. The nicotine in vaping products (e-cigarettes, vaporizers, vape pens, hookah pens, and e-pipes) is extracted from tobacco and mixed with other chemicals to form the e-liquid containing the flavorings, propylene glycol, vegetable glycerin, and other ingredients that are electronically heated to create the aerosol that users inhale (see the next section).

After entering the body, nicotine from any source moves rapidly into the blood and is delivered within seconds to the brain. Nicotine increases brain levels of dopamine and other neurotransmitters, which activate nerve pathways in the brain that produce feelings of pleasure and increased concentration. This fosters repeated consumption of nicotine and addiction to the drug over time. Also, soon after nicotine enters the body, the user generally experiences a

“rush” or “kick” caused in part by the drug’s stimulation of the adrenal glands and resulting discharge of *adrenaline* (epinephrine). The rush of adrenaline causes an increase in blood pressure, respiration, and heart rate and the ability to sustain attention and hold information in memory. Nicotine is also responsible for the nausea and vomiting experienced by most beginning users. The initial effects of nicotine are short-lived, causing the user to continue dosing to maintain the drug’s pleasurable effects and prevent withdrawal symptoms (irritability, craving, depression, anxiety, cognitive and attention deficits, sleep disturbances, and increased appetite). Withdrawal symptoms may begin within a few hours after the last dose of nicotine, driving users to redose.



Smoking: Not Much Fun Facts

Erectile dysfunction (ED). Many studies confirm that smoking increases the risk of men not being able to get or maintain an erection (Biebel et al., 2016). The risk is related to the number of cigarettes a man has smoked in his life. Recovery of erectile function is possible only if a man stops smoking and has not been a smoker for a long time. Smoking contributes to ED by altering the function of pelvic blood vessels.

Tooth decay. Tobacco smoking increases the risk of tooth decay (dental caries) in adults.

“Light” cigarettes. Cigarettes labeled *low-tar*, *mild*, *light*, or *ultralight* are not less harmful to health than regular cigarettes. That’s because smokers of these kinds of cigarettes inhale more deeply or smoke more cigarettes in order to maintain a constant dose of nicotine.

Money pit. Assuming a pack of cigarettes costs \$8, a pack-a-day smoker’s habit would cost \$2,920 a year. If, instead of buying cigarettes, a beginning freshman smoker stopped smoking and invested the money spent on cigarettes at a 3.5% per year return, on graduation day nearly 4 years later the student would have \$11,268.05. Congratulations! Buy a nice graduation present.

Genetic changes in immune cells. Smoking alters the activity of a gene in blood cells that is instrumental in immune system function—a reason for the observation that smoking compromises immune function.

Impaired brain function. Compared to children who breathe smoke-free air, children chronically exposed to environmental tobacco smoke (secondhand smoke) score lower on math, reading, and problem-solving tests.

In addition the direct effects of nicotine on brain and body biology, people can experience pleasure and comfort from just the feel, smell, sight, handling, and igniting a nicotine-delivery device. Learning processes in the brain associate these cues with dopamine surges in the brain. Even among former users of nicotine-delivery systems, cravings may persist because of the power of these cues. Behavioral therapies can help smokers identify environmental triggers of craving and develop strategies to avoid these triggers and manage the feelings that come from them.

E-Cigarettes (Vaping)

E-cigarettes (“e” stands for electronic) are devices that deliver to the body nicotine, flavorings (e.g., fruit, mint, and chocolate), and other chemicals via an inhaled vapor, which is the reason using e-cigarettes is called *vaping*. Typically, e-cigarettes are composed of a rechargeable, battery-operated heating element, a replaceable cartridge that contains nicotine or other chemicals, an atomizer that, when heated, converts the contents of the cartridge into an inhalable vapor, and the chemical propylene glycol to help the vapor stay moist. Propylene glycol is widely used in foods and medicines to keep products moist. Whereas this chemical is harmless when eaten, its effect on the lungs when inhaled is unknown. E-cigarettes are often made to resemble cigarettes, cigars, and pipes and, for those who wish to camouflage their use, nontobacco items such as pens and USB memory sticks.

Some studies suggest that e-cigarettes can help smokers stop smoking (Hajek et al., 2019). Even if smokers quit tobacco successfully by using e-cigarettes, they are still addicted to nicotine, which could increase the possibility of resuming smoking. Also, there are concerns that the millions of young people who start using e-

cigarettes will become addicted to nicotine and eventually become tobacco smokers. Furthermore, the vapor in e-cigarettes may eventually damage lung tissue. Tests have shown that the vapor contains tiny amounts of heavy metals (known to be carcinogenic) that are released from the solder in the metal coil.

As long as the manufacturers do not claim that e-cigarettes have any therapeutic value, they are unregulated by the Food and Drug Administration (FDA). In many states, there are no restrictions on the sale of e-cigarettes to minors. Should studies indicate that e-cigarettes pose a danger, the FDA has announced that it is prepared to issue regulations concerning the manufacture and sale of e-cigarettes, just as it does for tobacco products.

Increasing e-cigarette use among U.S. adolescents and adults is cause for concern. One concern is the potential of e-cigarettes to cause acute nicotine toxicity, which is characterized by vomiting, rapid or pounding heart rate, abdominal cramps, agitation, muscle twitching, confusion, convulsions, rapid or difficulty breathing, coma, fainting, and headache. Long-term effects of nicotine exposure include accelerated coronary and peripheral vascular disease and stroke, high blood pressure, slow wound healing, pregnancy problems, ulcers, and esophageal reflux. Recent research indicates that nicotine ingestion from using vaping products is dangerous, especially with regard to causing damage to lung tissue and even lung cancer (Marques et al., 2021).

The most frequent users of e-cigarettes are youth, who are tantalized by the promise of feeling grown-up and socially included, and smokers who are trying to quit and ex-smokers who quit with the help of e-cigarettes and continue nicotine ingestion as a hedge against smoking again (Mayer et al., 2020).

The FDA regulates the manufacture, import, packaging, labeling, advertising, promotion, sale, and distribution of e-cigarettes. This includes components and parts of e-cigarettes but excludes accessories. Under FDA regulations designed to protect the health of young Americans, minors cannot buy e-cigarettes in stores or online.

Your health is bound to be affected if day after day you say the opposite of what you feel.

—**Boris Pasternak**, *Doctor Zhivago*

Freedom from Nicotine Addiction

Nicotine is one of the most addicting of drugs. Fortunately, a variety of methods are available for those for who want help freeing themselves from nicotine's grip. Two prescription medications—*bupropion* and *varenicline*—help lessen cravings for nicotine. **Nicotine-replacement therapy (NRT)** involves controlled exposure to nicotine from nicotine-containing skin patches, chewing gum, nasal and oral sprays, inhalers, lozenges, and tablets (National Library of Medicine, 2021). The purpose of NRT is to reduce withdrawal symptoms by providing a small, controlled amount of nicotine without the dangerous chemicals found in cigarette tobacco and some e-cigarettes. Commonly, NRT involves using a nicotine patch together with another type of NRT such as gum or lozenge to increase effectiveness. Professional guidance helps develop a quit plan, ensure the chosen nicotine-containing methods are used in the appropriate doses, and help modify psychological and social habits that were involved in prior nicotine exposure. Guidance can take the form of telephone helplines, automated text messaging, mobile devices, and social media.

Marijuana and Its Derivatives

Marijuana refers to the dried leaves, flowers, stems, and seeds from the plants *Cannabis sativa* and *Cannabis indica*. These plants have been cultivated for hundreds of years in tropical and temperate climates all over the world as sources of hemp fiber for making clothing and rope, and for substances that, when ingested, produce euphoria, a sense of relaxation, mood elevation, heightened sensory awareness, pain relief, and other effects. The principal psychoactive substance in marijuana is the chemical **delta-9-tetrahydrocannabinol (THC)**. THC is chemically similar to natural substances in the brain called *endocannabinoids* that modulate appetite, pain sensation, mood, memory, and other processes by binding to specific receptors in brain tissue. THC binds to the same cannabinoid receptors. Cannabis plants also produce nonpsychoactive chemicals, the most abundant of which is **cannabidiol (CBD)**, which has medicinal effects including pain relief.

Marijuana can be rolled up and smoked like a cigarette (a *joint*) or a cigar (a *blunt*) and also smoked in a pipe. To avoid inhaling smoke from burning the plant material, which can be toxic, some people use vaporizers to release THC into an ingested vapor. Some vaporizers use a liquid marijuana extract. Marijuana can be mixed in food (*edibles*) and brewed as a tea. THC in high concentrations can be obtained from extracts, oils, and concentrates of the marijuana plant (*hash oil* or *honey oil*, a gooey liquid; *wax* or *budder*, a soft solid with a texture like lip balm; *shatter*, a hard, amber-colored solid). This practice is called *dabbing*. THC can also be manufactured from basic chemicals.

Worldwide, about 150 million people per year use marijuana (World Health Organization, 2020). About 20% of North Americans ages 18 to 25 use marijuana each month. About 30% of American college students report using marijuana in the prior 3 months (National College Health Association, 2020).

Besides its intended psychoactive effects, marijuana ingestion may evoke confusion, anxiety, panic, hallucinations, and paranoia. Speech and short-term memory may be impaired, which may be interpreted as humorous changes in one's normal mental state. However, because perception, motor coordination, and reaction time are also impaired, driving a car or operating other machines while intoxicated with THC is unsafe. Marijuana use may also aggravate an existing mental health problem.

Some of the possible health dangers of long-term marijuana use include the risk of bronchitis caused by marijuana smoke, increased heart rate and blood pressure, and possibly a slight depression of immune system functions. Marijuana smoke, like tobacco smoke, contains carcinogens.

Brain-imaging studies support a body of psychological research showing an association between heavy marijuana use and impairment in short-term memory and attention, loss of internal control, and reduced learning while a person is intoxicated—but not beyond the time of marijuana use. Heavy, extended marijuana use is associated with lower performance in school and at work, lower educational attainment, and other illicit drug use.

Several THC-containing products have been approved for the treatment of nausea in patients undergoing cancer chemotherapy and to stimulate appetite in patients with wasting syndrome from AIDS. A mouth spray combining THC and CBD is available in the United Kingdom, Canada, and several European countries for treating symptoms that may accompany multiple sclerosis. A CBD-based liquid medication has been approved for the treatment of two forms of severe childhood epilepsy. These medications use purified chemicals derived from or based on those in the marijuana plant. This avoids potential contamination by unknown, active chemicals in a batch of marijuana plant material and any adverse effects from smoking it. Many countries and American states have legalized the dispensing of marijuana or its extracts for a range of medical conditions. Only Canada, a few other countries, and some U.S. states have totally legalized marijuana for personal use. Some jurisdictions have decriminalized marijuana use, meaning personal

use is still illegal but not prosecuted. In the United States, marijuana is considered by the federal government as a Schedule I controlled substance, putting it in the most dangerous category of drugs.

Caffeine

Caffeine is a natural stimulant found in a variety of plants used in coffee, tea, chocolate, and soft drinks (**Table 14.3**). These beverages and foods are an integral part of American eating habits and may be enjoyed partly for their psychoactive properties.

TABLE 14.3 Caffeine Content of Beverages and Chocolate

Item	Amount	Caffeine Content (Milligrams)
Coffee, generic brewed	8 oz	130-200
Starbucks brewed coffee (grande)	16 oz	320
Starbucks vanilla latte (grande)	16 oz	150
Espresso, generic	1 oz	30–90
Tea, brewed	8 oz	40–120
Arizona iced tea, green	16 oz	15
Soft Drinks	12 oz	34–54 (range)
7-Up, regular or diet	12 oz	0
Fanta, all flavors	12 oz	0
5-Hour Energy Shot	2 oz	200
Rockstar Energy Drink	16 oz	160
Spike Shooter	8.4 oz	300

Item	Amount	Caffeine Content (Milligrams)
Rip It, all varieties	8 oz	100
SoBe No Fear	8 oz	83
Red Bull	8.3 oz	80
Jolt caffeinated gum	1 stick	45
Hershey's chocolate bar	1.55 oz	9
Hot cocoa	8 oz	9 (range: 3–13)
NoDoz (maximum strength)	1 tablet	200
Vivarin	1 tablet	200
Excedrin (extra strength)	2 tablets	130
Anacin (maximum strength)	2 tablets	64

Data from Caffeine Informer. (2021). Caffeine database. Retrieved from <https://www.caffeineinformer.com/the-caffeine-database>.

The effects of caffeine are familiar to most people. They include decreased drowsiness and fatigue (especially when performing tedious or boring tasks), faster and clearer flow of thought, and an increased capacity for sustained performance (for example, keyboarding faster with fewer errors). In higher doses, caffeine produces nervousness, restlessness, tremors, and insomnia and may have a negative effect on performance of complex tasks. In extremely high doses (10 grams, or about 100 cups of coffee), it can produce convulsions, which can be fatal.

In the past, caffeine was prescribed for a variety of complaints, but it is rarely used medically anymore. However, it is still a key ingredient in more than a thousand over-the-counter drugs. For example, many supposed *energizers* and *stay-awake* products are

pure caffeine. Pain relievers, cough medicines, and cold remedies contain caffeine to counteract the drowsiness produced by other ingredients in these medications. Caffeine is also put into weight-control and menstrual pain products because it increases urine output and water loss.

Psychological dependence may result from chronic use of caffeine, and tolerance to the stimulant effect may gradually develop. Mild withdrawal symptoms such as headache, irritability, restlessness, and lethargy may occur when caffeine use is stopped.

Critical Thinking About Health

1. After about a month, it was clear that inviting Chris to be their roommate had been a brilliant move. With a 3.9-plus GPA, Chris was a fountain of help with every subject from history to chemistry. Getting into law school was a foregone conclusion. The real question was how to get Chris on *Jeopardy!*

When midterm exams rolled around, the roommates noticed that Chris was coming home every day with a 12-pack of beer—six cans would disappear before dinner and the rest disappeared as the night's studying progressed. Although Chris showed no signs of impairment from ingesting this quantity of alcohol, the roommates were concerned.

- a. What concerns might the roommates have? If you were Chris's roommate, would you be concerned?
 - b. Given Chris's obvious success in school and the fact that Chris shows no outward sign of impairment, would you agree or disagree that Chris has a problem with alcohol?
 - c. Do you think Chris's roommates should try to change Chris's drinking behavior or is it none of their business?
2. "I don't like alcohol all that much. And it's never fun to wake up and find that you vomited all over yourself and don't remember doing it. There have been times I don't know how I got home, and I only hope that whoever drove the car wasn't as wasted as I was. Still, you need it. There's no better way to destress after a hard week of school. And you need to drink so you can be loose at a party. No one wants to dance with a loser, much less have sex with them."

What is your opinion of this person's attitude? Do you disagree with this student's philosophy? Explain your reasons.

3. Cigarette smoking costs the United States and Canada more than \$100 billion a year in healthcare costs and lost productivity. These

costs are borne equally by nonsmokers and smokers.

- a. Should nonsmokers pay for the healthcare expenses of people who smoke? Why or why not?
 - b. Should cigarettes be taxed by the government to cover their full cost to society, which could lessen tobacco consumption, put tobacco growers out of business, and drastically reduce tobacco companies' profits?
4. Bob Kozlo came home from work early one day. Upon hearing his dad's car pull up in the driveway, Jamie, Bob's 16-year-old son, quickly disposed of the joint he and his friend Max were sharing. Mr. Kozlo, who as a teenager also had experimented with marijuana, smelled the telltale odor and knew immediately what Jamie and Max had been up to.
- a. Should Mr. Kozlo ignore this situation or take some kind of action—and, if so, what should he do?
 - b. Should he tell Max's parents?
 - c. What is your opinion of teenagers experimenting with marijuana or any other drugs, including alcohol and tobacco?

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Offering someone an alcoholic drink is a sign of hospitality and friendship in many cultures and countries around the world. Taking a small amount of wine is an important part of some Christian religious services. Celebrating weddings, births, anniversaries, and other festive occasions with champagne is commonplace. Alcohol consumed in large quantities, however, can lead to garrulity, boisterous and aggressive behavior, and eventually to drunkenness and unconsciousness. Many heavy drinkers do not have the ability to control their consumption of alcohol and develop an alcohol use disorder, a major health problem for both drinkers and their families.

The destructiveness of alcohol misuse is evidenced by high rates of domestic violence, date rape among college students, child abuse and neglect, and violence of many kinds. Drinking and driving is a hazard to oneself, other drivers, and pedestrians. One-third of all traffic fatalities involve drinking and drunkenness. Even a small amount of alcohol in the body affects judgment and driving skills. For a variety of reasons, many people choose not to drink. If you choose to drink, set limits for yourself. When drinking, do not engage in activities that may harm yourself or others. “One for the road” is the most dangerous invitation you will ever receive.

Besides alcohol, tobacco and other nicotine-containing products—all of them legal—cause disease and death. A major reason the United States and other countries permit this is that political leaders benefit financially. Some countries are even financial partners of tobacco companies and actively promote cigarettes to their citizens. When the U.S. government wanted to put stronger health warnings on cigarette packages and vaping products, nicotine-delivery companies argued that doing so infringed on their right to free speech. The nicotine industry is a friend to no one.

Tobacco smoke contains more than 40 chemicals known to cause cancer, and many others cause heart disease. Each year in the United States, about 440,000 deaths (about one in every five deaths) are caused by smoking cigarettes or being exposed to cigarette smoke in the environment. Vaping damages lung tissues. Nicotine upsets brain chemistry and is one of the most addictive substances known. Nicotine addiction is powerful, but it can be overcome with a commitment to doing so and the help of a variety of proven methods.

Marijuana has long been promoted as a so-called gateway drug to the misuse of other brain- or mind-altering substances such as amphetamines and heroin. For this reason, marijuana has been outlawed for about a century in the United States and most other countries. Whereas chronic marijuana use can be problematic and marijuana intoxication can cause accidents and memory difficulties, long-overdue research on the health and psychological effects of marijuana show that the drug is far less harmful than the reputation that precedes it, and jurisdictions are taking notice and declassifying the plant as dangerous.

HIGHLIGHTS

- Alcohol abuse is a major drug problem in the United States. Consumption of alcohol is responsible for one-third of all highway fatalities and for numerous social, family, and health problems.
- Alcoholic beverages contain ethyl alcohol, which is produced by the action of yeast on sugar (fermentation) in grains and the juices of berries and fruits. Beer and wine are direct products of fermentation; *hard liquors* such as whiskey, vodka, rum, and brandy is made from distilled fermented liquids. Most standard portions of alcoholic beverages contain 0.6 ounce of ethyl alcohol.

- Drinking on campus increases the risk of academic problems, unintended pregnancy, and violence, including sexual assault.
- Alcohol enters the bloodstream within minutes after ingestion. A blood alcohol content of 0.02 produces a “loosening-up” effect; a BAC of 0.08 seriously impairs motor coordination and judgment; in most states it is illegal to drive with a BAC of 0.08.
- Frequent and constant use of alcohol can lead to an alcohol use disorder, consisting of neurobiological dependence and tolerance for the drug (alcoholism). Alcohol use disorder develops in stages, starting with the inability to control drinking and advancing to complete neurobiological dependence.
- Alcoholics may encounter severe health problems, and their personal lives, family relationships, and friendships may be disrupted. Millions of children who grew up in families where one or both parents were alcoholics experience personal problems as adults that stem from their childhoods.
- Organizations such as Alcoholics Anonymous and individual or group psychotherapy can help people recover from problem drinking and alcoholism. Alcohol abuse can be prevented by taking responsibility for one’s drinking behavior.
- No public health message is disseminated as widely as the warning that cigarette smoking is dangerous to your health.
- Tobacco smoking is responsible for 440,000 American deaths per year, far more than AIDS, auto accidents, and drug use combined. Smoking increases the risk for heart disease, lung cancer, respiratory diseases, and cancers of all kinds.

- Environmental tobacco smoke contains the same 4,000 chemicals and 43 carcinogens that inhaled tobacco smoke does, thus affecting the health of nonsmokers.
- Vaping harms lung tissues and its resultant nicotine addiction can lead to tobacco dependence.
- Nicotine addiction can be overcome with the help of medications.
- Even though marijuana ingestion alters brain physiology, the substance is less harmful than its reputation suggests.
- Nearly 90% of Americans regularly ingest caffeine (mostly via coffee and tea), many of them appreciating its stimulant effects (decreased drowsiness and fatigue, faster and clearer flow of thought, and increased capacity for sustained performance).

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KEY TERMS

moderate drinking:

For men, defined as having an average of two or fewer drinks per day (14 drinks per week); for women, defined as having no

more than one drink per day (7 drinks per week)

binge drinking:

For men, consuming five or more, and a woman consuming four or more, drinks in about two hours

blood alcohol concentration (BAC):

the amount of alcohol in the blood

heavy alcohol use:

binge drinking on 5 or more days in the past month

high-intensity drinking:

drinking that is two to three times the threshold amounts of binge drinking

alcohol use disorder:

alcohol consumption that causes distress or harm; also known as alcoholism or alcohol abuse

secondhand binge effects:

negative experiences caused by another's binge drinking

ethyl alcohol (ethanol):

the consumable type of alcohol that is the psychoactive ingredient in alcoholic beverages; often called grain alcohol

proof:

a number assigned to an alcoholic product that is twice the percentage of alcohol in that product

hangover:

unpleasant physical sensations resulting from excessive alcohol consumption

alcoholism:

loss of control over drinking alcohol

delirium tremens (DTs):

hallucinations and uncontrollable shaking caused by withdrawal of alcohol in alcohol-dependent individuals

tolerance:

a condition in which increased amounts of a drug or increased exposure to an addictive behavior is required to produce desired effects

withdrawal:

uncomfortable and sometimes dangerous reactions that occur after a person stops taking a physically addicting drug

blackout:

failure to recall normal or abnormal behavior or events that occurred while drinking

bender:

several days of continued drinking

enabling:

denial of, abetting, or excusing another's addictive behaviors

denial:

refusal to admit you (or someone else) have a drinking problem

codependency:

a relationship pattern in which the nonaddicted family members identify with the alcoholic

nicotine:

a potent nervous system stimulant in tobacco leaves

second-hand smoke:

tobacco smoke released into a smoker's surroundings

tar:

yellowish-brown residue from tobacco combustion and a documented cause of lung cancer

e-cigarettes:

electronic devices that deliver nicotine, flavorings, and chemicals to the user through inhaled vapors

nicotine replacement therapy (NRT):

the use of nicotine-containing products such as skin patches and chewing gum to help a smoker end smoking

marijuana:

the dried leaves, flowers, stems, and seeds from the plants *Cannabis sativa* and *Cannabis indica*

delta-9-tetrahydrocannabinol (THC):

the principal psychoactive substance in marijuana

cannabidiol (CBD):

cannabis plant product with nonpsychoactive properties but medicinal effects such as pain relief

caffeine:

a natural stimulant found in a variety of plants used in coffee, tea, chocolate, and soft drinks



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CHAPTER 15

Making Decisions About Health Care



Health Tips

Treating a Headache with Acupressure



Dollars & Health Sense

Unhealthy Lifestyles Raise Healthcare Costs



Managing Stress

Healthcare Professionalism Versus Personal Beliefs



Wellness Guide

How Does Your Hospital Rate?

Hope Helps Healing and Recovery

Self-Care: My Personal Vital Statistics

LEARNING OBJECTIVES

1. Describe how to be a wise healthcare consumer.
2. Describe the main kinds of healthcare providers.
3. Compare the four main kinds of private health insurance available in the United States.
4. Explain which populations are served by Medicare and Medicaid.
5. Discuss several reasons why healthcare costs are high in the United States.
6. Discuss some of the problems with the quality of U.S. health care and frequency of medical errors.

7. Define and give examples of health disparities.
8. Define the four categories of alternative medicines.
9. Discuss the reasons why some people choose an alternative medicine in addition to or instead of modern medicine.
10. Explain how to avoid being victimized by health fraud.

Everyone needs health care at some time—for vaccinations, physical exams and diagnostic tests, and treatment when sick. Occasionally, people need to be hospitalized for serious illness, injury, or surgery. Quality health care and the cost of medical services are among people's most important concerns. Both state and federal governments have systems to ensure that all citizens have some form of health insurance and can receive health care when needed, but millions of Americans do not have private health insurance.

God heals and the doctor takes the fee.

—Benjamin Franklin

Being a Wise Healthcare Consumer

Making wise decisions about health products and health services and obtaining health information is part of self-care and self-responsibility. Above all, one must choose health practitioners with great care and be willing to ask questions about fees, diagnoses, standard and alternative treatments, and obtaining second opinions. Being a wise healthcare consumer includes the following basic principles: (1) working in partnership with your healthcare provider, (2) sharing in healthcare decisions, and (3) becoming skilled at obtaining health care.

Patient–Provider Partnership

Communication is extremely important in the patient–healthcare provider relationship. The American Medical Association’s policy is that “the patient has the right to receive information from physicians and to discuss the benefits, risks, and costs of appropriate treatment alternatives.” Many healthcare providers want to inform patients fully of their medical situation and options, although some do not. A provider may be too busy with an overloaded schedule to discuss with a patient all she or he wishes to. Some providers feel that her or his moral values or religious beliefs justify not being fully open with a patient regarding options (see the Managing Stress box titled “Healthcare Professionalism Versus Personal Beliefs”). Alternatively, a provider might recommend unnecessary tests and procedures to boost profits for itself or its employers or to avoid being sued for malpractice. For all of these reasons, consumers should choose healthcare providers in whom they have complete confidence and trust.

As a partner in your own health care, at the first sign of a health issue for which you seek professional help, you should observe and record symptoms so that you and your healthcare provider can better manage your situation, prepare a list of questions you want to

ask, a list of your symptoms, and the name of any medications or other treatments for your symptoms. During your visit, be open and honest when asked about personal activities such as sexual relations, smoking and drinking behavior, misuse of prescription medications or use of illegal drugs, or other questions you might feel embarrassed to discuss.



Healthcare Professionalism Versus Personal

Beliefs

Healthcare professionals have an obligation to provide all patients nondiscriminatory access to medical services. Claiming violations of their “conscience,” some healthcare professionals refuse to help people in need. At least 45 states now have “laws of conscience” that allow healthcare professionals to refuse any service that violates their conscience, including the following:

- refusing to care for someone of a particular religion, political affiliation, sexual orientation, or gender status;
- refusing to counsel a patient about the availability of emergency contraception or to write a prescription treatment, even for a rape victim;
- refusing to counsel infertile couples as to their options using reproductive technologies such as artificial insemination;
- refusing patients’ requests not to use painful or futile treatments;
- refusing to vaccinate someone for a nonmedical reason;
- refusal by a pharmacist to fill a prescription for a pregnancy prevention method; and
- refusal to counsel patients regarding end-of-life options or to follow a patient’s health directives.

Most professional healthcare organizations consider healthcare professionalism to mean doing the utmost in every situation to relieve suffering and to help others in distress. Whereas it seems that considerations of personal autonomy are important, most providers do not believe that “conscience” overrides professional commitments to relieve suffering. Author C. S. Lewis wrote:

Of all tyrannies, a tyranny sincerely exercised for the good of its victims may be the most oppressive. It would be better to live under robber barons than under omnipotent moral busybodies. The robber baron’s cruelty may sometimes sleep, his cupidity may at some point be satiated; but those who torment us for our own good will torment us without end for they do so with the approval of their own conscience. (Charo, 2005)

Shared Decision-Making

Consumers have the right to participate actively in every medical decision in partnership with their healthcare providers (except in the emergency room, where informed consent is not required). There are numerous ways to share in healthcare decisions: (1) Let your doctor know what you want, (2) do your own research, (3) ask why a test or treatment is recommended, (4) ask about alternatives, (5) consider watchful waiting as an alternative to immediate treatment, (6) state your healthcare preferences, and (7) accept responsibility for the course of treatments.

Learn about healthcare costs.

There are many ways to cut the cost of health care without affecting the quality: (1) Exercise self-care and self-responsibility, (2) seek health care from a primary healthcare provider, (3) reduce unnecessary medical tests, (4) reduce drug use, (5) use specialists only when necessary, (6) use emergency services only for actual emergencies, and (7) use hospitals only when recommended by a physician.

Choosing a Healthcare Provider

Healthcare Providers

All physicians are trained in and practice *Western medicine*, which is based on modern scientific principles and methods and rigorous testing to determine the safety and efficacy of treatments or medicines. Besides physicians, the delivery of modern health care is carried out by many kinds of trained specialists (see [Table 15.1](#)). Physicians are the primary source of medical advice and care, but their tasks would be impossible to carry out without the help of other healthcare professionals, who are described next.

TABLE 15.1

Selected Medical Specialists

After receiving their MD degrees, physicians can specialize. This involves several additional years of training. Medical specialty boards certify physicians in a specialty by examination. Some medical specialties are described in this table.

Specialty	Specific Focus
Allergy and immunology	Prevention, diagnosis, and treatment of allergic disease
Anesthesiology	Administration of drugs to prevent pain or to induce unconsciousness during surgical operations or diagnostic procedures
Cardiology	Diagnosis and treatment of diseases of the heart and blood vessels, including such problems as heart attacks, hypertension, and stroke
Dermatology	Diagnosis and treatment of skin diseases
Endocrinology	Care of medical problems that result from abnormalities in the endocrine (hormone) system in the body
Family practice	General medical services for patients and their families

Geriatrics and gerontology	Concerned with problems of the elderly
Hospitalist	A physician who cares only for patients admitted to a hospital
Internal medicine	Diagnosis and nonsurgical treatment of internal organs of the body
Neurology	Diagnosis and nonsurgical treatment of diseases of the brain, spinal cord, and nerves
Obstetrics and gynecology	Care of pregnant women and treatment of disorders of the female reproductive system
Oncology	Diagnosis and treatment of all forms of cancer
Ophthalmology	Medical and surgical care of the eye, including prescription eyeglasses
Orthopedics	Diagnosis and treatment of abnormalities in bone and muscle, especially injuries resulting from sports activities
Pathology	Examination and diagnosis of organs, tissues, body fluids, and excrement
Pediatrics	Medical care of children, usually up to teenage years
Preventive medicine	Prevention of disease through immunization, good health care, and concern with environmental factors
Psychiatry	Treatment of mental and emotional problems
Public health	Subspecialty of preventive medicine that deals with promoting the general health of the community
Radiology	Use of radiation for the diagnosis and treatment of disease
Urology	Treatment of male reproductive system and urinary tract and treatment of female urinary tract

Physician Assistants

Physician assistants (PAs) are trained in many aspects of medical care. They work independently and also under the supervision of a

physician. PAs supervise other members of the physician's health team and perform complex diagnostic and therapeutic procedures. Often, the PA can spend more time with the patient than the physician does and usually can answer most of the patient's questions regarding medications or operations.

Nurses

Registered nurses (RNs) are trained to promote health, advise patients on how to prevent disease, and assist in clinical care. Hospital RNs are in frequent contact with sick patients and monitor their progress, administer medications, and record progress and problems. RNs assist physicians during treatments, surgeries, and examinations. Nurses may specialize in such areas as surgical, cancer, maternity, or emergency room care. Other areas of specialization include home health nurses, occupational health nurses, and public health nurses.

Nurse practitioners are RNs with additional training and skills that enable them to provide many primary care services. They take medical histories and perform physical exams. They also counsel patients and make preliminary diagnoses before referring patients to a physician.

Emergency Medical Technicians

Emergency medical care is delivered at home and accident sites by emergency medical technicians (EMTs) and paramedics. EMTs work in hospitals and with police and fire departments. Paramedics have more advanced training that enables them to perform a variety of emergency procedures for sick or injured people needing immediate attention. EMTs and paramedics are trained in ways to safely move seriously injured people and can communicate with hospital physicians to determine the best course of emergency treatment.

Physical and Occupational Therapists

Physical therapists (PTs) are trained to restore function, improve mobility, and relieve pain of patients suffering from an injury or a disease. Physical therapists usually work in hospitals or medical

clinics and work with patients who are referred by a physician. PTs help patients regain mobility and strength and train them in exercises that can hasten their recovery.



Interacting with Your Physician

- You should choose a physician you trust and in whose medical skills you have complete confidence. Expend the time and effort to find a primary care physician who can satisfy your medical needs. He or she should be someone to whom you can openly express your health concerns.
- Clear and open communication between you and your physician is essential. You should understand the nature of your medical problems and the reasons for any tests that are ordered. You should feel free to ask about different treatment options. You are entitled to all the information pertaining to your condition in language you can understand.
- You should feel confident enough to share with your physician any emotional problems you may have or any stress in your life. This information may be important in arriving at an accurate diagnosis and treatment recommendation. If you are upset in your interaction with a physician, the art of healing is not being practiced.
- To help calm yourself when you are visiting your healthcare provider, relax your mind and body by taking three calming breaths, practicing a meditation, or doing an image visualization exercise.
- Always remember how suggestible your mind is during a medical consultation. What the physician says about your condition can be as important in the healing process as the treatment. If the physician is positive and encouraging, the likelihood of success is increased.
- The most difficult but essential discussions you need to have with your healthcare provider are the ones that make you feel embarrassed or ashamed; for example, substance use; sexual and relationship problems and abuse; uncontrolled eating; excessive stress, anxiety, depression; and other mental health issues. Remember that disclosures with your healthcare provider are confidential and that not withholding important information is your part of the bargain in being a good patient. Even if your primary care physician is not able to treat your condition, you are likely to be referred to a competent health professional who can. It is crucial that you follow up on recommendations to obtain help. The sooner a problem is addressed, the more likely you are to have a positive outcome and to feel better.

Occupational therapists (OTs) help people in the workplace perform their daily tasks even if they have some disability or injury. OTs can help workers who spend long hours at a computer or checkout counter avoid physical and mental stress and avoid a repetitive motion injury. They are trained counselors and often work with PTs to help workers recover from illnesses or injuries.

Sports Medicine

Sports medicine involves the coordinated efforts of many different kinds of healthcare providers and specialists, including orthopedic surgeons, trainers, coaches, physical therapists, nutritionists, psychologists, and other healthcare providers.

Seeing the Doctor

The majority of people who go to a doctor have minor complaints, are there for a routine checkup or follow-up of some chronic problem, or may simply need some kind of reassurance. In general, patients fall into three categories: (1) those who think they are sick and are, (2) those who think they are well but are actually sick, and (3) the *worried well* who are not sick but seek reassurance that they are not sick. This last group may account for as many as half of all patients who are seen by family practice physicians.

Although some physicians encourage annual checkups, most studies show that frequent medical exams for people who are basically healthy are unnecessary. How often you see a physician depends on your personal needs, but many people go to a physician for minor complaints and illnesses that may not require medical attention ([Table 15.2](#)). Often people are asking more from their doctors than just medicine.

TABLE 15.2

The 20 Most Common Reasons for Doctor Visits

One in eight people goes to the doctor without any complaint or symptom.

Rank	Reason
1	Progress visit, not otherwise specified
2	General medical examination
3	Postoperative visit
4	Cough
5	Medication, other and unspecified kinds
6	Hypertension

7	Prenatal examination, routine
8	For other and unspecified test results
9	Counseling, not otherwise specified
10	Diabetes mellitus
11	Knee symptoms
12	Back symptoms
13	Stomach and abdominal pain, cramps, and spasms
14	Gynecological examination
15	Well-baby examination
16	Shoulder symptoms
17	Low back symptoms
18	Types of surgery
19	Symptoms referable to throat
20	All other reasons

Data from Centers for Disease Control and Prevention. (2013). *National ambulatory medical care survey: 2013 summary tables*. Retrieved from http://www.cdc.gov/nchs/data/ahcd/namcs_summary/2013_namcs_web

Patient satisfaction with health care usually depends on what occurs in the practitioner's office. Anxiety about what may be wrong, long waits to see the physician, and a seemingly endless number of tests can contribute to patients' satisfaction . Diagnosis is separate and distinct from treatment. In any illness, there are two important choices: first, admitting that you are sick and finding out what is wrong, which is the process of the **diagnosis**; and second, deciding what is the best course of treatment based on the diagnosis.

Hospitals

Many Americans will be admitted to a hospital at some time during their lives. For many people, the hospital experience is confusing and frightening. To cope with this unpleasant reality, one should understand a hospital patient's rights.

On admission to a hospital, a patient is required to sign a consent form delegating all decisions regarding his or her care to the hospital and physicians. In most instances, physicians obtain informed consent for any invasive procedure, either diagnostic or therapeutic, before proceeding. But the amount of information that is given to the patient and how well a patient understands the proposed treatment usually depend on many factors that affect communication between the patient and the physician. The American Hospital Association publishes *The Patient Care Partnership* to describe the situations and questions most often encountered by hospital patients (<https://www.aha.org/other-resources/patient-care-partnership>). Ask for this when in a hospital.



How Does Your Hospital Rate?

Use this list of organizations to find ratings of hospitals on many different criteria.

Organization	Website
Consumer Reports magazine	http://www.consumerreports.org/health/hospitals/ratings
Hospital Inspections	http://www.hospitalinspections.org
The Joint Commission	http://www.qualitycheck.org/

Organization	Website
The Leapfrog Group	http://www.hospitalsafetygrade.org
<i>U.S. News and World Report</i>	http://health.usnews.com/best-hospitals/rankings

The most frustrating and anxiety-producing situations for a patient are not understanding what is going to happen and, even worse, not knowing what is happening while being subjected to unfamiliar and uncomfortable procedures. Except in the case of a life-threatening emergency that demands immediate action, you have the right to be fully informed of all medical procedures and the reasons for them. As a patient (or a patient's advocate), you have the responsibility for deciding what you want done. Once you have made that decision, you should understand how to cooperate fully with the healthcare team to gain the most benefit.



For many people, the hospital is an impersonal and confusing place. Developing good communication with healthcare providers and knowing your rights as a consumer can help combat those feelings.

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Health Insurance

Health insurance is a system intended to pay some or all of the costs of a person's medical, surgical, and hospital care. The basic principle of health insurance is that individuals contribute money regularly (usually monthly) to a fund from which contributors can withdraw money to pay for their medical expenses. In some countries such as Canada and Mexico, all health insurance is provided by a government-run system paid for by personal and business taxes. This is called *single-payer*, *universal*, or *public health insurance*. An alternative to a single-payer system is having each person obtain medical insurance from a private insurance company, which is similar to buying car insurance. Often private health insurance is obtained through one's employer with the employer bearing some or all of the cost. The medical insurance system in the United States and some other countries is a combination of public (Veterans Administration, Medicare, Medicaid) and private (employer, self) funding (**Figure 15.1**).

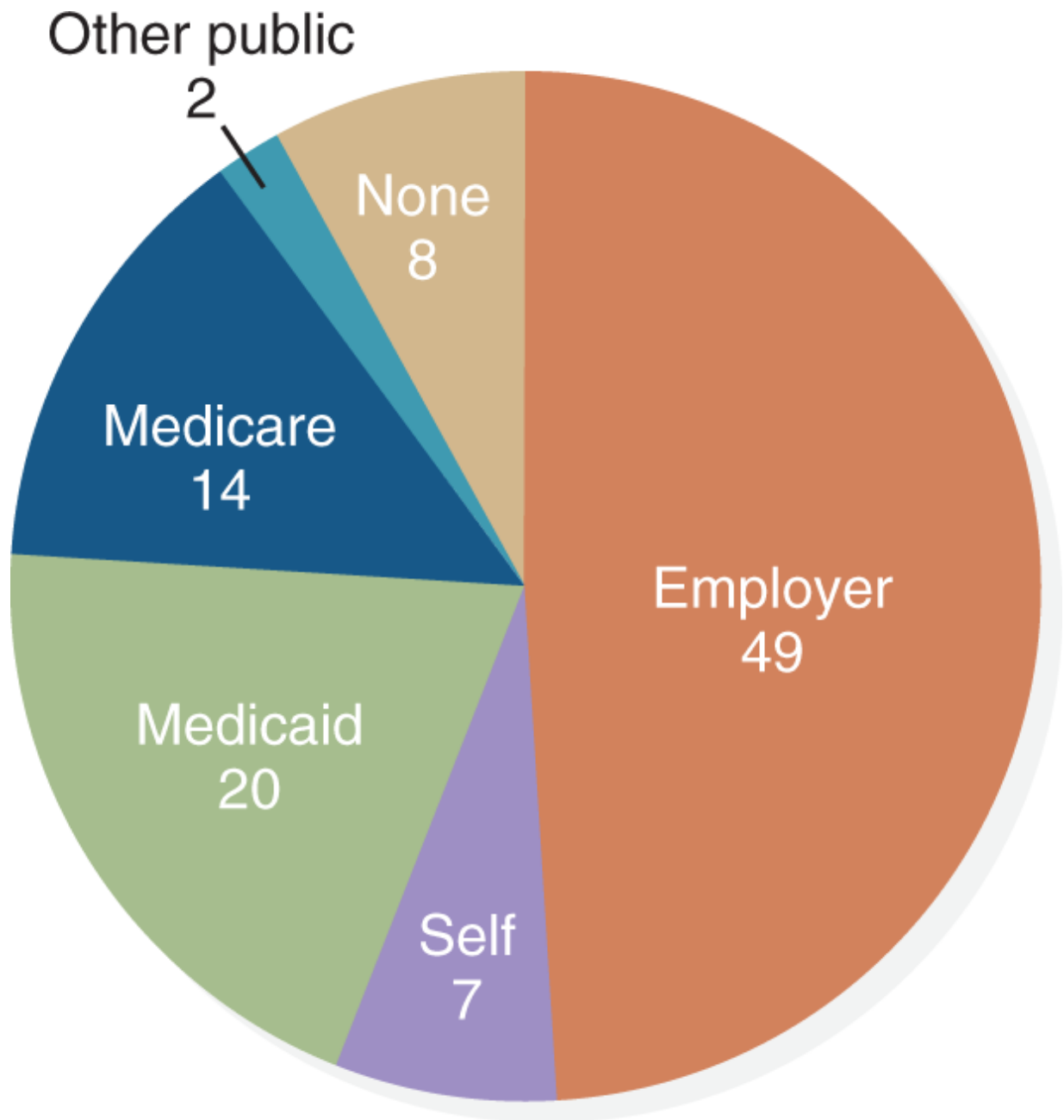


Figure 15.1 Adult Health Insurance Coverage in United States by Percentage.

Data from Kaiser Family Foundation (2017). Health Insurance Coverage of the Total Population. <http://www.kff.org/other/state-indicator/total-population/>

Many kinds of health insurance are available in the United States, depending on a person's age, employment status, medical history, and financial resources. Large employers generally pay for health insurance for their employees and their dependents. The U.S.

government provides health insurance for federal employees, members of the armed services, and veterans and their dependents. Federal, state, and local governments provide health insurance for the elderly and the disabled. However, the U.S. government does not provide universal health insurance for all citizens as is the case in most other industrialized nations.

Types of Private Health Insurance

Private health insurance plans fall into two broad categories: (1) fee-for-service plans (also called *indemnity plans*), and (2) some form of **managed care** plan, which includes health maintenance organizations, preferred provider organizations, and point-of-service plans. About 90% of all Americans who have health insurance are enrolled in some kind of managed care plan. One of the primary goals of all managed care plans is to control the costs of health care. Important features of each health insurance plan are outlined in the following subsections.

Fee-for-Service Plans

Fee-for-service (indemnity) health insurance plans allow a person complete freedom in choosing a physician or a hospital. For a fixed monthly fee, these plans will pay some fraction of the patient's medical costs, usually 80%.

Although most indemnity plans give a person great flexibility in choosing healthcare providers, many restrict the kinds of services they will pay for. Most will not pay for routine physical exams, immunizations, drug abuse programs, and mental health services. Subscribers to these plans must understand which healthcare services are covered and which are not and be sure a plan fits their needs. Also, paying 20% of the costs may be no hardship for minor healthcare needs. However, if a major illness requires surgery and hospitalization, costs can run into hundreds of thousands of dollars; 20% of such a large sum may be more than most people can afford.

Health Maintenance Organizations

Health maintenance organizations (HMOs) are prepaid health insurance plans. HMOs are characterized by four principles defined by Congress in the Health Maintenance Organization Assistance Act of 1973: (1) an organized system of health care that accepts the responsibility to provide health care, (2) an agreed-upon set of comprehensive health maintenance and treatment services, (3) a voluntarily enrolled group of people in a specific geographic region, and (4) reimbursement through a prenegotiated and fixed payment schedule on behalf of the enrollee.

Choosing the best HMO for your needs can be difficult, especially if choices are limited by your place of employment or financial resources. Some independent organizations attempt to rate the quality of HMOs. Check carefully what each HMO offers, especially for emergency care or for chronic conditions. If you are enrolled in an HMO, find a physician that you trust and with whom you can communicate freely. If you are not satisfied with a diagnosis or treatment, consult another doctor or ask for a second opinion.

Preferred Provider Organizations

Preferred provider organizations (PPOs) are a combination of the traditional fee-for-service healthcare plan and an HMO. Employers or insurance companies negotiate low fees with selected hospitals and healthcare providers. Participants in PPOs must use one of the “preferred” providers. If a participant opts for care from a nonprovider, then he or she will be charged a substantial fee.

Point-of-Service Plans

A point-of-service (POS) plan is a twist that some HMOs offer. Usually a primary care physician in an HMO is required to refer you to a specialist who is also a member of the same HMO. However, in a POS plan, you can be referred to a physician who is not a member and still receive coverage. However, if you choose to go to an

outside physician without a referral, then you will have to pay all or part of the costs.

Choosing a health insurance plan requires time and thought. Take into account your particular health needs. Don't be afraid to ask questions. Any plan that includes drug coverage will be considerably more expensive than one that does not include such coverage.

Public, Government-Provided Health Insurance

The U.S. government provides health insurance for about 37% of Americans through three programs: the Veterans Administration, Medicare, and Medicaid, and their various subsidiary programs (Kaiser Family Foundation, 2017). The U.S. government has been involved in supplying health insurance to veterans, but not other citizens, since the birth of the Republic. Today, the U.S. Department of Veterans Affairs, also called the Veterans Administration or VA, serves 9 million veterans in more than 1,000 clinics and hospitals.

In 1965, the U.S. Congress created Medicare, which provides health insurance for people age 65 and older, disabled people younger than 65, and persons with permanent kidney failure. All eligible Medicare beneficiaries, on reaching age 65, automatically are enrolled in Medicare Part A which covers hospital costs, rehabilitation in a skilled nursing facility, and hospice care for the terminally ill. Enrollment in Medicare Part B is voluntary, but most beneficiaries choose to enroll. Part B pays for 80% (after a \$100 deductible) of physicians' services, emergency room visits, laboratory fees, diagnostic tests, and other medical expenses.

In 1966, during its first year, Medicare had 19 million enrollees; by 2018 the number had increased to about 60 million and is expected to increase to 80 million (one in every five Americans) by 2030. Because of ever-rising healthcare costs, the federal government is always seeking ways to reduce Medicare costs. Possible changes are to curtail services, lower payments to doctors and hospitals, and increase the eligibility age for Medicare to age 68 or 70.

Also in 1965, Congress established Medicaid, which provides health insurance for people with low incomes. Medicaid is a joint federal and state program that, together with the Children's Health Insurance Program, provides health coverage to 75 million, mostly low-income Americans. Medicaid is the single largest source of

health insurance coverage in the United States. The federal government sets minimum standards for eligibility for Medicaid, and all 50 states participate in the Medicaid program to at least that level. However, eligibility for Medicaid benefits varies widely among the states, and each state can determine to what extent it will provide insurance beyond the minimum federal guidelines.



Unhealthy Lifestyles Raise Healthcare Costs

Many factors contribute to high healthcare costs in the United States, including payments to physicians, hospital costs, drug prices, overuse of diagnostic tests, billing fraud, and many others. A nonmedical reason for high healthcare costs is disease resulting from unhealthy lifestyles. The Centers for Disease Control and Prevention (CDC) has found that 75% of U.S. healthcare spending goes to treating “preventable” chronic diseases, such as type 2 diabetes and obesity. Annually, through their tax dollars, U.S. citizens spend about \$190 billion treating obesity, \$245 billion treating diabetes, and hundreds of billions more on cardiovascular diseases and cancers that were caused by unhealthy lifestyles and behaviors.

In 2010, Congress passed the Affordable Care Act (ACA) to address weaknesses in the provision of health and medical care in the United States, especially the fact that more than 40 million Americans then had no medical insurance of any kind. To remedy this, the ACA mandated that every person in the country have health insurance through a public plan, employer coverage, or a self-financed individual insurance plan, with the federal government subsidizing the cost for those who could not afford it. Moreover, the ACA extended to the states the option to provide Medicaid coverage to all individuals with incomes less than 138% of the federal poverty level. This is called the *Medicaid Expansion*. As of 2017, the ACA was responsible for providing health insurance for more than 31 million Americans, many of whom were of low income (**Figure 15.2**).

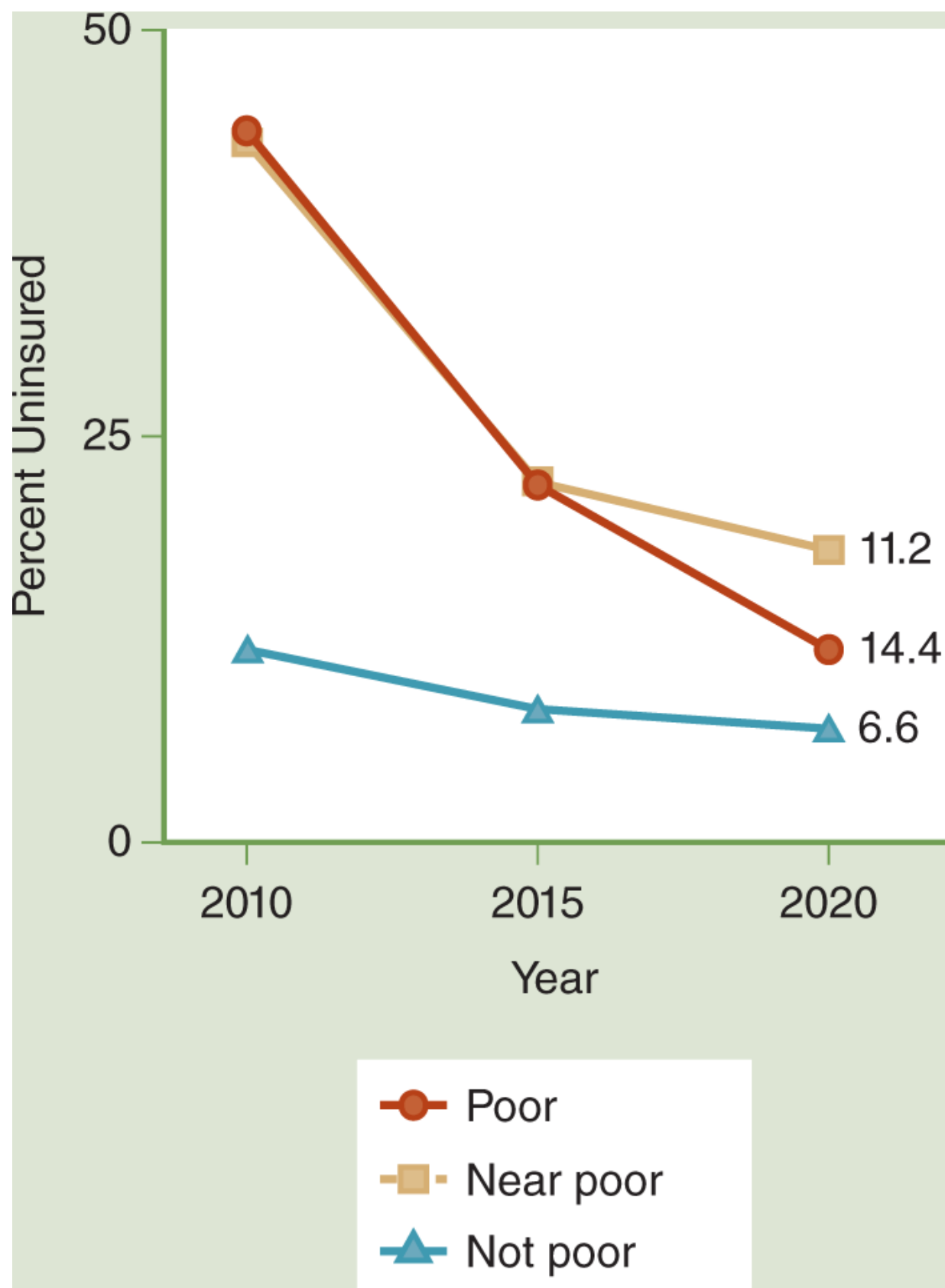


Figure 15.2 Percentage of Uninsured Adults by Socioeconomic Status, 2010–2020.

The percentage of uninsured adults ages 18–64 declined from 2010 to 2020 because of the Affordable Care Act. The decline is greatest among those categorized as poor and near poor, designated according to the U.S. Census Bureau's determination of the federal poverty level. The difference in percentages between poor and near poor in 2020 is the result of increases in the Medicaid Expansion benefit.

Data from Cohen R.A. et al. (2021). *Health insurance coverage: Early release of estimates from the National Health Interview Survey, April 2019–June 2020*. National Center for Health Statistics (<https://www.cdc.gov/nchs/data/nhis/earlyrelease/Quarterly-Estimates-2020-Q12-508.pdf>)

Description

Healthcare Costs

Healthcare Costs

Anyone who has been to a physician, filled a prescription, paid a health insurance premium, or been admitted to a hospital realizes how expensive medical care is. Many factors contribute to the high cost of health care in the United States: physician salaries and fees, cost of prescription drugs, malpractice insurance, cost of hospital rooms and emergency services, and cost of health insurance. Another significant factor is the aggressive marketing of new medical technologies and new drugs. The overzealous use of diagnostic technologies distinguishes U.S. medical care from that in other major industrialized countries. The United States leads the world in organ and bone marrow transplants, coronary artery bypass surgeries, and **magnetic resonance imaging (MRI)** use with incredibly expensive machinery. Another reason for high healthcare costs is waste in a variety of forms (Gawande, 2015). The Institute of Medicine (2013) estimates that 31% of healthcare dollars (about \$765 billion) is wasted (**Figure 15.3**). About half of the wasted money is lost to inflated charges, administrative costs, and fraud. The greatest waste comes from unnecessary healthcare services, with people being unnecessarily treated and prescribed drugs they do not need. Although the extent and sources of healthcare financial waste have been identified, few solutions have yet been adopted.

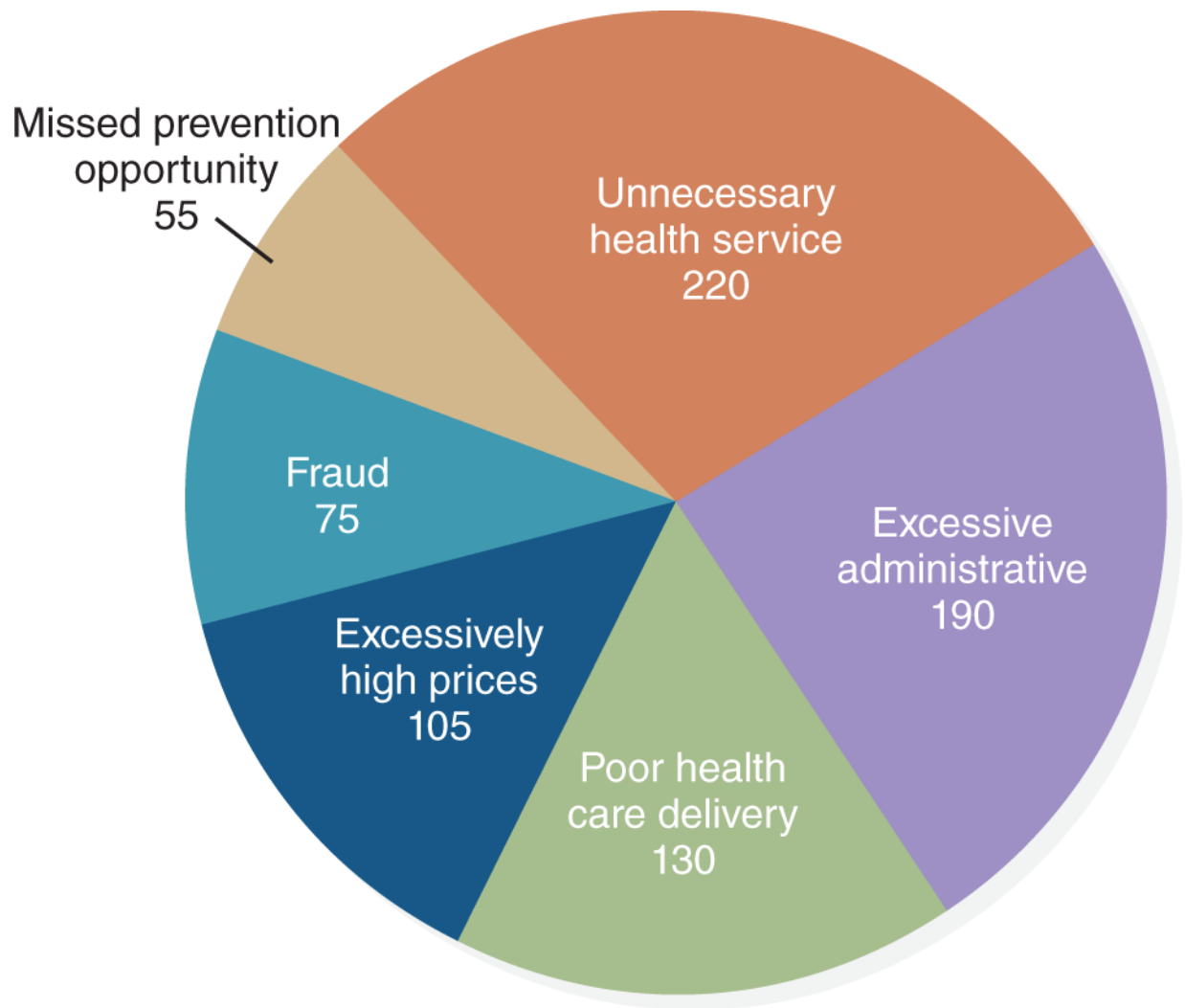


Figure 15.3 Sources of Financial Waste in U.S. Health Care (Billions of Dollars Per Year).

Data from Institute of Medicine (IOM). 2013. *Best Care at Lower Cost*. Washington, DC: National Academies Press.

Other factors contributing to healthcare costs are unhealthy lifestyles and an aging population (see the Dollars & Health Sense box “Unhealthy Lifestyles Increase Healthcare Costs”). The epidemic of obesity contributes to a bevy of chronic diseases, the most notable being type 2 diabetes. Diseases caused by smoking or alcohol are costly and preventable in principle. And, as the population ages, older Americans acquire chronic ailments that require more medical attention, including costly drugs and surgery.

Medical Tourism

Because of the extraordinarily high cost of medical and dental procedures in the United States, each year approximately 1.4 million Americans seek treatment in other countries (Dalen & Alpert, 2018). Thailand, India, Argentina, Costa Rica, Mexico, Israel, and South Korea are frequent destinations for medical tourists. A comparison of prices for some common surgeries in the United States and in four other countries shows why medical tourism is popular (**Figure 15.4**).

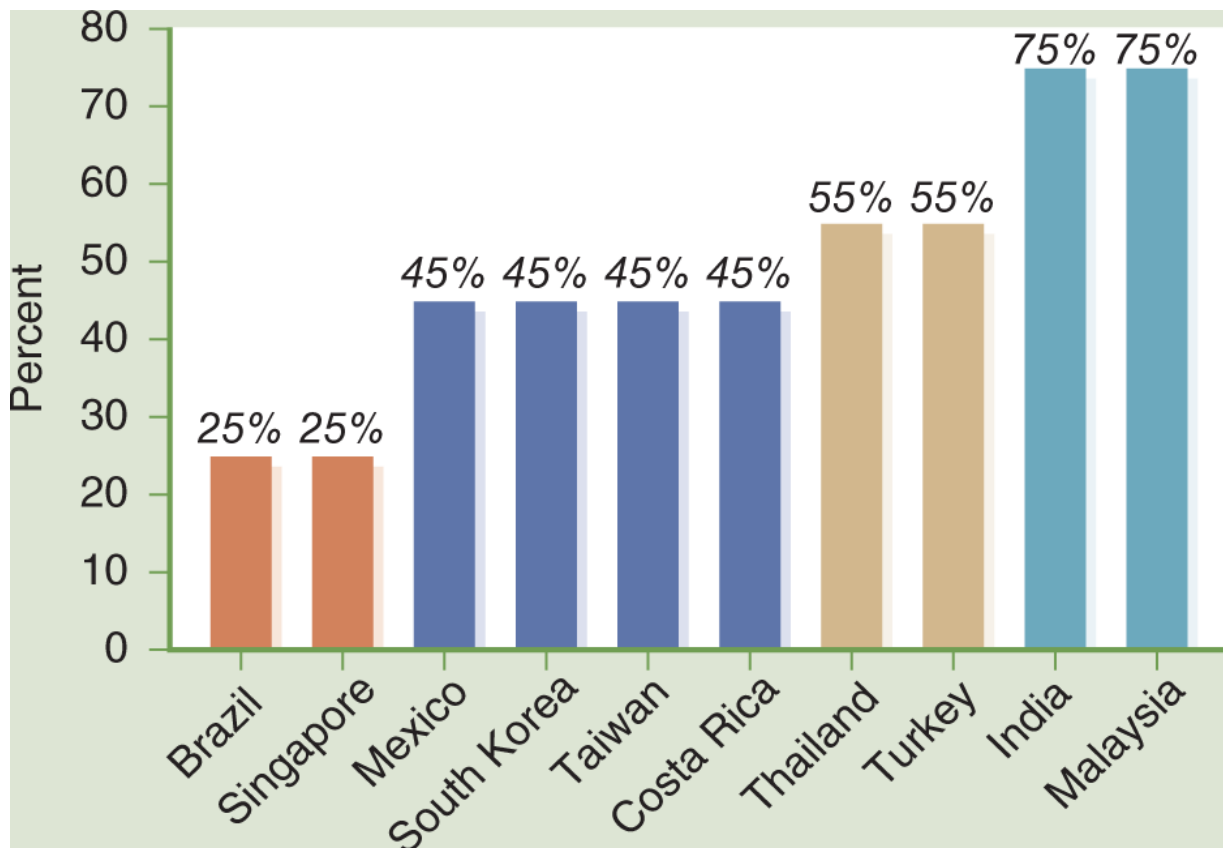


Figure 15.4 Average Cost of Medical Procedures of Most-Traveled Destinations Compared to the United States.

Data from Patients Beyond Borders. (2019). *Medical tourism statistics and facts*. Retrieved from <http://www.patientsbeyondborders.com/media>

Many non-U.S. hospitals are accredited by a U.S. organization called the Joint Commission International

(www.jointcommissioninternational.org). This nonprofit agency checks hospitals every 3 years and uses the same standards used to accredit American hospitals. Also, many surgeons working outside the United States have been *board certified*, which means that their qualifications are the same as surgeons working in U.S. hospitals. The American Board of Medical Specialties (www.abms.org) lists thousands of surgeons working in other countries who are board certified.



Computed tomographic scans and magnetic resonance imaging help physicians make the correct diagnosis of an injury or disease.

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All medical procedures entail risks, whether done in the United States or in other countries. People interested in medical tourism should do as much research as possible by checking sites on the Internet, including the CDC (<https://cdc.gov/travel/page/medical->

tourism), and talking with patients who have undergone procedures overseas. It is important to ask questions about follow-up care with your own doctor. Communicate with the overseas surgeon if possible. Sometimes it is wise to work with an overseas travel company that can make all of the medical arrangements.

Healthcare Costs in Other Countries

In the United States, healthcare costs are about \$10,000 per year per person. Other industrialized nations such as Canada, Great Britain, France, Germany, and Japan spend about half as much and still manage to provide health care for all of their citizens. On average, the United States spends \$750 more annually per citizen in administrative costs for health care than is spent in Canada. Some claim that the United States has the best health care in the world, which justifies the high cost. This may be true if you are a kidney dialysis patient or need a heart transplant. But the United States also has a lower life expectancy and a higher infant mortality rate than do many other industrialized countries. A comparison of the health systems of 11 developed countries (Davis et al., 2014) showed that the United Kingdom ranked first among the 11 countries in providing quality healthcare. And despite the fact that it spends much more money per capita on health care than any of the 11 countries, the United States ranked last overall (**Table 15.3**).

TABLE 15.3 | **Health Status Rank of the United States Among 11 Developed Countries**

Health Factor	Example	U.S. Rank
Effective care	Treatment and prevention	3
Safe care	Harmful medical errors	7

Health Factor	Example	U.S. Rank
Coordinated care	Providers work as a team	6
Patient-centered care	Heeding patient's needs and preferences	4
Cost-related access problems	Cost impedes access to care	11
Timeliness of care	Wait time for care	5
Efficiency	Administrative and legal costs	11
Equity	Gender, ethnicity, geographic location, SES*	11
Healthy lives	Infant mortality; healthy life expectancy	11
Overall		11

*SES: socioeconomic status.

Data from Davis, K., et al. (2014). *Mirror, mirror on the wall, 2014 update: How the U.S. health care system compares internationally*. Retrieved from <http://www.commonwealthfund.org/publications/fund-reports/2014/jun/mirror-mirror>

Ranking U.S. health care seventh in safety, the data indicate that efforts to improve patient safety, implemented by Congress in 2005, can be strengthened. Each year, about 250,000 Americans die from medical errors in hospitals (Makary & Daniel, 2016). Approximately half of these deaths are preventable. Hospital-based medical errors are the third leading cause of death in the United States.

Healthcare Disparities

Most Americans want affordable, efficient, and high-quality medical care for themselves and their families. One major factor in achieving these desires is taking personal responsibility for one's own health and the health of family members. Another major factor is reducing

as much as possible health disparities among social groups. **Healthcare disparity** generally refers to a higher burden of illness, injury, disability, or mortality experienced by one population group relative to another group. Healthcare disparities tend to be related to race or ethnicity, religion, socioeconomic status, education, gender, age, mental health, cognitive, sensory, or physical disability, sexual orientation or gender identity; geographic location; or other characteristics historically linked to discrimination or exclusion. Other determinants of health disparities include availability and access to a high-quality education, nutritious food, decent and safe housing, affordable and reliable public transportation, culturally sensitive healthcare providers, clean water and nonpolluted air, and access to affordable quality health care. The effects of race and sex on how long someone lives is an example of a health disparity (**Figure 15.5**).

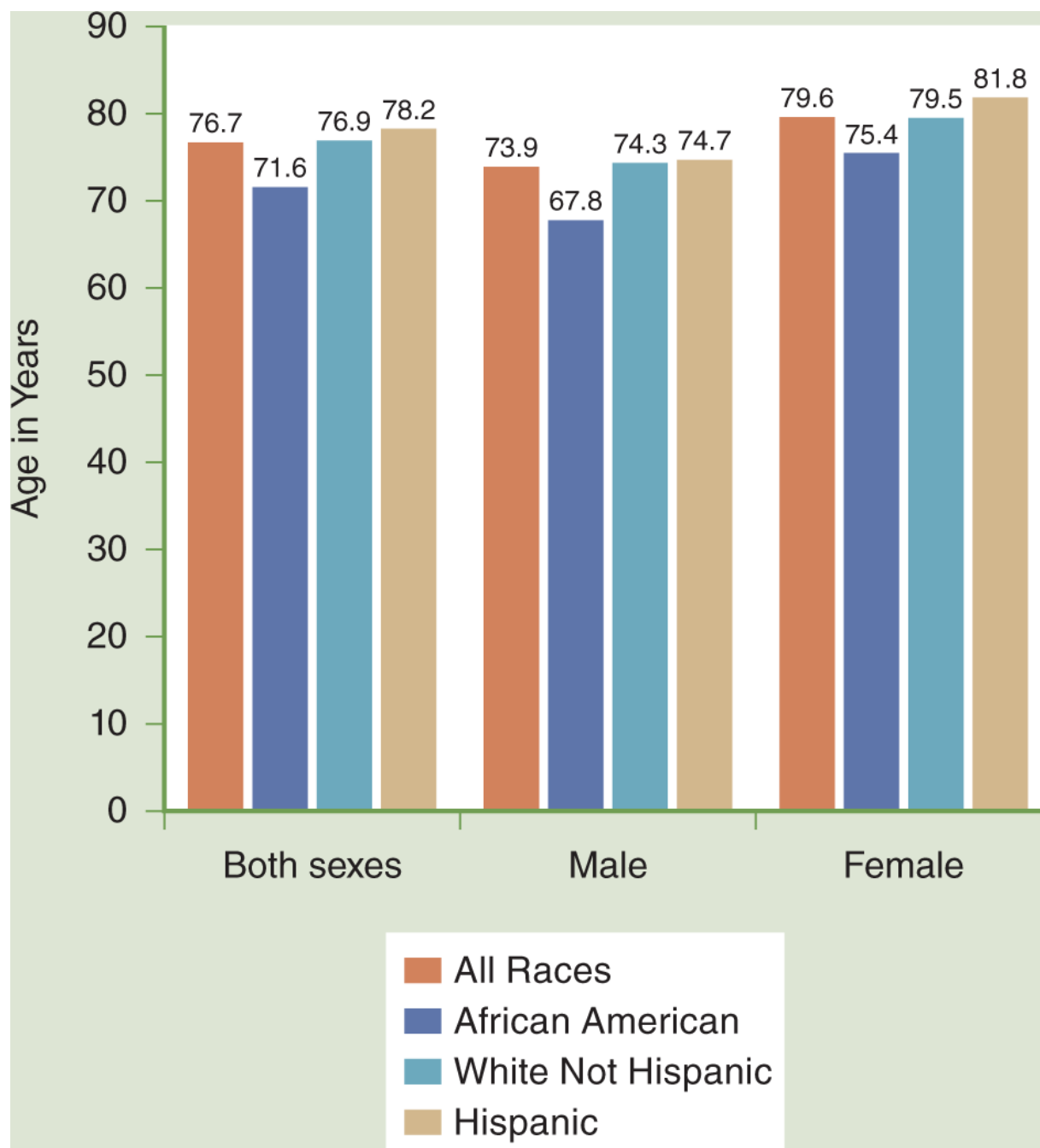


Figure 15.5 Racial Differences in Life Expectancy at Birth in the United States in 2021.

Data from Arias, E., Betzaida, T-V., Ahmad, F., & Kuchanek, K. D. (2021). Provisional life expectancy estimates for 2020. U.S. Centers for Disease Control and Prevention, Vital Statistics Rapid Release Report No. 15, <https://www.cdc.gov/nchs/data/vsrr/VSRR10-508.pdf>

Description

Organ Transplants

Most major human organs now can be transplanted from person to person, including kidney, liver, heart, lung, and pancreas, as well as eye and skin tissues. Organs can be transplanted from cadavers (people who have died suddenly, usually in accidents) and from living donors. About 34,000 Americans receive organ transplants each year; however, about 125,000 individuals seek them.

More than 71,000 people in the United States have donated an organ to another person, often a family member. Kidney donations are the most frequent because everyone has two kidneys, and one kidney can be donated without seriously affecting the donor—as long as the remaining kidney continues to function normally. Because of this risk, some hospital transplant centers prefer to transplant organs from older persons, but this also means the donor is at additional risk from the transplantation procedure, especially if she or he is not in the best of health.

No federal guidelines or state laws regulate who can donate and who can receive an organ. Each hospital or organ transplant center makes its own rules. Because of the lack of official guidelines, standards, and information, a person really cannot give *informed* consent.

Medicalization of Human Behaviors and Traits

Medicalization refers to medical consideration of conditions, behaviors, or traits that generally were not regarded as illnesses or medical problems. Once medicalized, these conditions are deemed to require treatment of some kind, such as psychotherapy, medication, or surgery. Once a condition has been medicalized, payment to doctors by health insurers is permissible.



Hope Helps Healing and Recovery

When faced with a serious health problem such as cancer or diabetes, signs of dementia, or disability from an accident, individuals tend to react with anger, despair, depression, or even thoughts of suicide. Confronting a serious health issue requires courage as well as competent intervention by physicians and other healthcare professionals. Improving the chances of recovery and restoring health requires active participation in all aspects of the care. To effectively assist in recovery requires dealing with one's personal mental state to become positive and hopeful about recovery.

Any form of treatment is substantially helped by a patient's hope for success (Harris & DeAngelis, 2008). The body and mind are capable of remarkable feats of healing when aided by hope and a positive attitude. At first, hope may have an element of pretense, but as one small improvement follows another, the hope becomes real and so does the healing. Those who do not give up usually get up.

Homosexuality is an example of a human behavior that has been medicalized (Conrad, 2007). For years homosexuality was stigmatized in the United States and other countries as a “disease” that required treatment with drugs, psychotherapy, and other methods. Homosexuality was officially demedicalized in the United States in the 1970s and is now viewed as a normal variation in a human trait.

Pharmaceutical companies are a major force in the medicalization of conditions that are not illnesses, such male pattern baldness, everyday stress, and female menopause. These conditions and their drug solutions are presented daily in mass media as permitted by direct-to-consumer advertising.

Obesity is a serious health problem that has been medicalized. Most often, obesity results from individual lifestyle choices, social forces that promote sedentary living, and the mega-industrialization of the food supply that provides products for consumption that increase the risk of overweight and obesity. Because changing lifestyle, social, and economic forces is difficult, pharmaceutical researchers are competing to find drugs that can stop weight gain or promote weight loss.

People do not have to accept being medicalized for some behavior or condition that requires them to be treated. Medicalizing is a form of exploitation that is detrimental not only financially but also to one's identity and sense of autonomy.

Precision Medicine

Much of current medical care is based on the premise that every patient with a particular set of symptoms or diagnosis should get the same treatment—that is, one that has been shown in rigorous testing to be effective in a large number of people. **Precision medicine** (also called *personalized medicine*) is different. Precision medicine is based on the premise that an individual's health and disease can be managed based on that person's unique biological characteristics, including, and especially, his or her genetic makeup. Precision medicine has become possible because thousands of specific genetic variants (changes in genes) have been identified that are causally involved with specific diseases. Thus, a patient's DNA can be examined for disease-causing changes and medicine can be offered for that specific situation, particularly cancers. Herceptin in the treatment of breast cancer is an example. It is effective only in cases in which the cancer was caused by a particular gene, called *HER2*. The anticancer drug Keytruda (pembrolizumab) is intended for people who carry a specific genetic abnormality that prevents cells from repairing damage to DNA (Garber, 2017). When cancer in just about any tissue arises, this genetic abnormality, which is present in about 1% of people, can be identified by genetic testing and the antitumor drug pembrolizumab can be prescribed.

Elective Cosmetic Surgery

For people who can afford it, elective **cosmetic surgery** is used to alter physical appearance. Each year about 12 million cosmetic surgical and nonsurgical procedures are performed in the United States (**Table 15.4**). In addition to cosmetic surgeries, about 5 million surgical reconstruction procedures are performed. Women receive about 90% of all cosmetic surgeries. Botox injections to remove wrinkles and age lines on the face are the most popular nonsurgical procedures among both men and women.

TABLE 15.4 | Most Frequent Cosmetic Surgeries in the United States, 2019

Procedure	Number
<i>Minimally Invasive</i>	
Botulinum toxin type A	5.1 million
Soft tissue fillers	23.8 million
Chemical peel	1.4 million
Laser hair removal	1.1 million
Microdermabrasion	680,000
<i>Cosmetic Surgical</i>	
Breast augmentation	257,000
Nose reshaping	362,300
Eyelid surgery	354,105

Procedure	Number
Liposuction	265,200
Tummy tuck	118,210

Data from American Society of Plastic Surgeons. (2019). *2019 Plastic surgery statistics report*. Retrieved from <http://www.plasticsurgery.org/news/press-releases/new-statistics-reflect-the-changing-face-of-plastic-surgery>.

Most cosmetic surgeries are safe, especially if performed by a board-certified physician. However, complications such as infections, scarring, and undesirable outcomes can occur. Liposuction is an example. It is used to remove subcutaneous fat from various parts of the body to sculpt it into a more attractive shape. A variety of complications can result from liposuction, some of which can be serious or fatal, so it is not a procedure to undergo lightly and without considerable investigation of possible undesirable outcomes.

Complementary and Alternative Medicine

Modern medical practice is based on a scientific understanding of the factors that contribute to the maintenance of health and treating disease to restore health. Because most of the original scientific principles that are basic to modern medicine were developed by scientists in Europe and North America, modern medicine is often referred to as *Western medicine*. Someone who has been trained in Western medicine studies a specific science-based curriculum that is taught in several hundred medical schools in the world, including about 90 in the United States and 17 in Canada. These individuals are referred to as *medical doctors* (MDs) or *physicians*.

Although many people choose to consult a physician when they are sick, others may also seek alternatives to Western medicine. For example, persons from cultures that rely on nonmedical healers, **herbal medicines**, and faith and religion to treat sickness may use their own remedies even if they have access to medical doctors. Non-Western approaches to maintaining health and treating sickness are called **alternative medicine** or **complementary medicine**. Combining Western medical methods and alternative ones is called **integrative medicine**. Individuals might choose an integrative approach to healing because Western scientific medicine has failed to relieve their suffering or cannot cure their disease. For example, people with cancer for which no Western medical treatments are available might seek an alternative healing practice that offers them hope, however faint, to cure their condition. People with chronic diseases such as arthritis, chronic fatigue syndrome, depression, or persistent allergies who do not respond satisfactorily to medical treatments often turn to alternative healing practices for relief.

You cannot teach a person anything. You can only help him to find it for himself.

One-third to one-half of individuals with serious medical problems use some form of integrative medicine in addition to conventional treatment. The integrative medicines that people use most frequently are meditation, deep breathing, massage, megavitamin therapy, and homeopathy (National Center for Complementary and Integrative Health, 2021).

Integrative medicine can be divided into four broad categories based on the method of healing or intervention: (1) spiritual, psychic, or mental approaches, including prayer, meditation, hypnotherapy, and faith healing; (2) nutritional therapies, including change in diet, fasting, and the use of supplements; (3) therapies using herbs or other substances derived from natural sources such as homeopathy, herbal medicine, or immune system boosters; and (4) physical therapies such as chiropractic, acupuncture, massage, and yoga. **Table 15.5** presents a partial list of the hundreds of different alternative medicines.

TABLE 15.5 Partial List of Alternative Medicines and Healing Methods

Physical and Nutritional	Mental and Spiritual
Acupuncture	Ayurveda
Alexander technique	Biofeedback
Ayurveda	Christian Science
Feldenkrais technique	Co-counseling
Herbal medicine	Guided imagery
Kinesiology (touch for health)	Hypnosis

Physical and Nutritional	Mental and Spiritual
Macrobiotics	Meditation
Massage	Past lives therapy
No nightshade diet	Primal scream therapy
Qigong	Progressive relaxation
Reflexology	Psychic healing
Shiatsu	Magnetic therapy
T'ai chi ch'uan	Psychodrama
Yoga	Rebirthing

Individuals should always discuss with their physicians any integrative healing practice they are using because some treatments may interfere with any conventional therapy or a prescribed drug, thereby reducing the medicine's effectiveness. Some integrative medical methods have not been fully tested for safety and efficacy. Moreover, some practitioners are not well trained in integrative medicine and some are unlicensed. Anyone contemplating using an integrative medicine should obtain as much information as possible before proceeding,



Self-Care: My Personal Vital Statistics

Enter the appropriate data about yourself. Date it and keep it for your personal records.

1. My height in feet and inches (without shoes): _____
2. My weight in pounds now (with clothes): _____
3. A. My highest weight as an adult: _____ pounds, which I weighed when I was _____ years old.

3. B. My lowest weight as an adult: _____ pounds, which I weighed when I was _____ years old.
4. My body mass index (BMI) is _____ (Online calculator: https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm)
5. My estimated daily calorie requirement as calculated below:
Step 1: I am _____ feet _____ inches tall.
Step 2: My body mass units = _____ (as calculated below):
Women: Give yourself 100 body mass units for first 5 feet of height + 5 body mass units for each additional inch. Men: Give yourself 106 body mass units for first 5 ft of height and 6 body mass units for each additional inch.
Step 3: My estimated activity factor is: sedentary = 13; active = 15; very active = 17
Step 4: My estimated daily calories = (body mass units) × (activity factor) = _____
6. My resting heart rate (pulse) is: _____ beats per minute
How to measure your heart rate video (<https://www.youtube.com/watch?v=qPKVfT5L4X8>) OR How to measure your heart rate text (<https://www.webmd.com/heart-disease/heart-failure/watching-rate-monitor?page=2>).
7. My target heart rate zone is between _____ and _____ beats per minute
Online calculator: <https://www.cancer.org/healthy/eat-healthy-get-active/get-active/target-heart-rate-calculator.html>;
Chart: <https://www.heart.org/en/healthy-living/fitness/fitness-basics/target-heart-rates>
8. My blood pressure is (ask your doctor): systolic (top number) _____ diastolic (bottom number) _____
9. My blood cholesterol is: Total _____; LDL _____; HDL _____
Ask your doctor or get these values measured.
10. My blood type is _____. Ask your doctor or get results from your next blood test
11. Medicines I take for these reasons: _____, _____, _____

Examples of Complimentary and Integrative Medicinal Practice

Ayurveda

Ayurveda refers to one of the world's oldest healing systems, which has been practiced in India for more than 4,000 years. Ayurveda teaches that health results from a balance of mind, body, and spirit as well as a balance between people and the environment and their relationship to the cosmos. The word *Ayurveda* is from Sanskrit and a combination of two words: *ayur*, which means "life," and *veda*, which means "knowledge." Thus, health is knowledge of life. Ayurveda is becoming increasingly popular in Western countries.

An Ayurvedic practitioner diagnoses a patient's disease by a technique called *pulse diagnosis*, a highly developed skill in taking a pulse. Also, signs of illness are found by examination of the tongue, urine, and the condition of the nails, skin, and lips. Once the nature of an imbalance is determined, the practitioner provides various remedies, including healthy nutrition, exercise, yoga, t'ai chi, massage, meditation, and herbal remedies.

Homeopathy

Homeopathy is primarily a self-healing system that is assisted by the administration of small amounts of a conventional medicine or a remedy derived from animals or one or more plants. For example, the substance belladonna, which is extracted from a poisonous plant, causes flushing and flulike symptoms when ingested by a healthy person. Thus, a homeopathic practitioner might use diluted doses of belladonna to treat the flu or high fever. The final diluted solution contains only a miniscule amount of belladonna. From a scientific perspective, administering minute amounts of an active substance, in itself, is highly unlikely to be an effective biologically

based treatment of an illness. Nonetheless, homeopathy helps many people, perhaps an example of the placebo effect.

Many health practitioners provide patients with homeopathic substances. Self-health homeopathic products are also available as sugar pellets to be placed under the tongue or as ointments, gels, drops, creams, and tablets. Treatments are “individualized” or tailored to each person; different people with the same condition can receive different treatments. Homeopathy is used by millions of people all over the world, including about 6 million Americans each year (Dossett et al., 2018). The word *homeopathy* derives from two Greek words: *omoios*, meaning “similar,” and *pathos*, meaning “feeling.”

Chiropractic

Chiropractic is based on the premise that virtually all diseases are caused by *subluxed* (misaligned) vertebrae. **Subluxation** can be caused by genetic disorders, falls, injuries, improper sleeping habits, poor posture, obesity, stress, or occupational hazards. When the spine is in complete alignment, energy flows freely to all tissues and organs in the body and is the basis for health. The name *chiropractic* is from the Greek *cheir*, meaning “hand,” and *praktikos*, meaning “practical”; the two words are usually interpreted to mean “done by hand.”

Chiropractic exists as two distinct schools, the *straights*, who adhere to the original idea that almost all diseases are caused by subluxation of the vertebrae, and the *mixers*, who believe that factors other than subluxation are involved in disease processes. Treatment by mixers include nutrition, relaxation, exercise, and other techniques, along with spinal manipulation. Although chiropractors treat a wide range of diseases, 90% of patients seek chiropractic because of back pain, neck pain, or headaches. Several research studies have demonstrated both short-term and long-term benefits of chiropractic for chronic, disabling lower back pain.

Osteopathy

Osteopathy, like chiropractic, is basically treatment by manipulation of the spine and other structural parts of the body. Osteopathic physicians, called *doctors of osteopathy* (DOs), undergo rigorous training in Western medicine and generally have the same medical and legal privileges for prescribing drugs and performing surgery as do physicians.



Chiropractic manipulations help many people who suffer from back pain and other musculoskeletal disorders.

© Albina Glisic/Shutterstock

Acupuncture

Acupuncture is an integral part of traditional Chinese medicine and has been used in China and other Asian countries for centuries. It became popular in the United States after President Nixon's visit to China in the 1970s. A *New York Times* reporter, James Reston, who was covering Nixon's trip, became ill and underwent an emergency

appendectomy. He later wrote an article describing his acupuncture anesthesia, and American physicians began traveling to China to learn more about acupuncture.

The underlying principle of acupuncture is the existence of *qi* (pronounced *chi*)—the vital life force that circulates throughout the body and is carried by channels called **meridians**. There are 12 major meridians that connect all of the major organs, as well as a network of minor meridians. The meridians intersect with the surface of the body at many positions; these are the acupuncture points that are “needled” to restore balance to the *qi* to cure illness or relieve pain. According to Chinese medicine, an organ that is diseased or not functioning properly will manifest symptoms or signs on a corresponding meridian. These may include pain or ache, a change in temperature, sensitivity to touch, or a change in skin texture or color along the affected meridian. Thus, the acupuncturist must first diagnose the cause of the illness by locating the affected meridians; then the correct acupuncture points can be treated.



Treating a Headache with Acupressure

Many people experience headaches caused by tension in the muscles of the neck and head. Often the tension alters blood supply to the brain, which causes a headache. Pressing acupressure points at two different locations may relieve the headache pain. The points are located just below the base of the skull, at the back of the head, just to the right and left of center.

Cup the back of your head with both hands and use your two thumbs to press quite firmly just under the skull on either side of center. The thumbs should be an inch or so apart and away from the centerline of the skull. Apply firm but not painful pressure for up to a minute or until your thumbs become tired. Breathe deeply while pressing. Repeat the pressure two or three times.

Two other acupressure points for headache relief are located on the back of each hand in the soft part between thumb and index finger. Using the thumb and index finger (or middle finger) of the opposite hand, press firmly on the acupressure point. This point may be sensitive, so press only as hard as is comfortable. Repeat on the opposite hand. Press these points for up to a minute and repeat several times. Notice if the headache pain has subsided.

In acupuncture treatment, extremely thin metal needles are inserted just under the skin at specific acupuncture points (**Figure 15.6**). Traditional Chinese medicine describes about 365 acupuncture points located along 12 meridians in the body. Usually no more than a dozen or so needles are used. These remain in place for about a half hour, during which they may be twirled or connected to low-voltage generators to increase effectiveness in balancing qi. Sometimes heat is applied to the acupoint in a process called *moxibustion*. A small piece of an herb, *Artemisia vulgaris* (commonly known as *mugwort*), is either burned on the tip of the needle or placed on the acupoint.

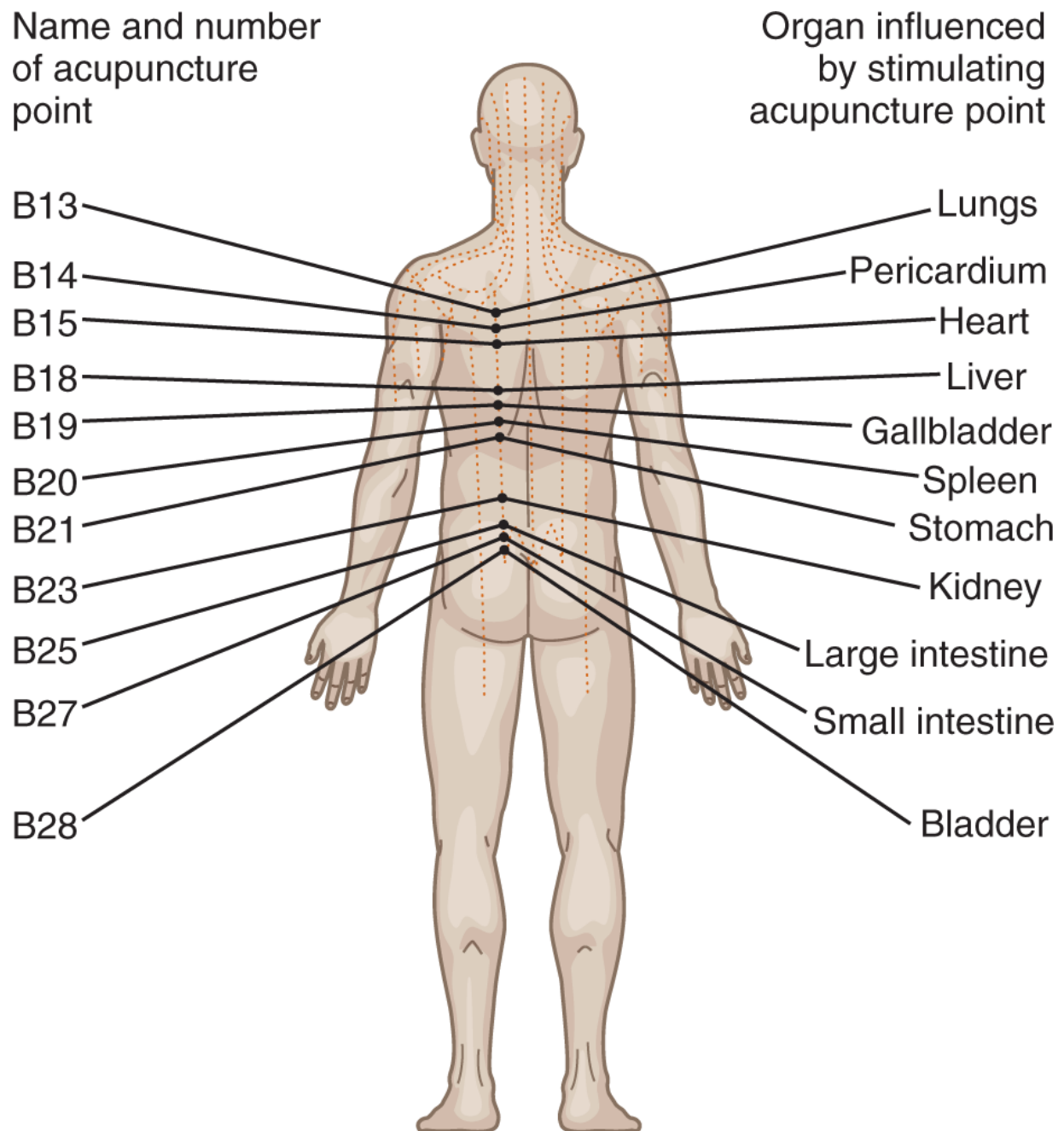


Figure 15.6 Acupuncture points supposedly influence the functions of internal organs.

Description

Studies of the effects of acupuncture treatment suggest that it might be helpful for a variety of conditions, many of which involve pain (Kelly & Willis, 2019). Acupuncture may provide modest benefits in the treatment of chronic low back pain, tension headache

and chronic headache, migraine headache, and dental pain. Although scientific evidence is lacking, people receiving acupuncture for acute low back pain and knee osteoarthritis report less pain, which may be the result of a placebo response. For people who are unable to receive standard medical therapies, acupuncture's placebo effect presents a reasonable option.

A problem shared is a problem halved.

—English proverb

Naturopathy

Naturopathy emphasizes the prevention of disease and the individual's responsibility for a healthy lifestyle. Naturopathy draws on other integrative medical practices as well as aspects of Western medicine. However, it does reject the use of surgery and drugs. If there is a single unifying concept to naturopathy, it is that the body possesses the “energy” or “intelligence” to heal itself. In that sense it is similar in philosophy to Ayurvedic and Chinese medicine.

Naturopathic doctors receive training as complete as a medical school that awards the MD degree. A naturopathic doctor who has graduated from one of the half dozen schools offering degrees in naturopathy is well equipped to diagnose and treat a wide range of diseases. Because naturopathy eschews the use of surgery and drugs, naturopathic doctors do not treat acute illness or conditions that require emergency care. People usually consult a naturopathic doctor to construct a lifestyle that will prevent illness and promote overall optimal health with healthy nutrition, stress management, and help in reducing destructive health behaviors such as smoking, excessive drinking, or using recreational drugs.

Therapeutic Massage

Therapeutic massage is a hands-on therapy in which touch delivered by a licensed practitioner is a highly effective form of therapy for many conditions (Barreto & Batista, 2017). The most immediate effect of therapeutic massage is improved blood circulation. As the skin is stretched and the muscles are kneaded, the amount of blood returning to the heart is increased, and toxins released into the blood can be excreted more readily. Enhanced circulation also supplies more oxygen to tissues and to the brain. Massage benefits digestion and elimination, and it hastens wound healing. Massage also eases muscle pain caused by strain or injury; it may stimulate the release of endorphins and enkephalins, pain-relieving chemicals synthesized in the body. Certain conditions and diseases in which therapeutic massage should *not* be used are recent bone fractures or severe sprains, herniated disks in the spine, excessive blood pressure, any acute inflammation of the skin or joints, blood conditions such as phlebitis and thrombosis, and certain kinds of cancer.

Aromatherapy

Aromatherapy is a centuries-old practice in which essential oils of plants (many of which are fragrant) are administered so that chemicals contained in the oils are absorbed into the body and act as drugs. The modern medicinal use of plant oils and fragrances, as well as the term *aromatherapy*, derives from a French chemist who began to study the healing power of plant oils in the 1930s. He became interested after burning his hand in his family's perfume factory. He plunged his burned hand into a vat of lavender oil for relief and discovered that the burn healed rapidly and without scarring.

Essential oils made from plant extracts are highly concentrated and contain hundreds of chemicals that can act as drugs. Thus, only minute amounts of oils are used. A person practicing aromatherapy needs to be knowledgeable about the kinds of chemicals present in different extracts and their effects on the body. Aromatherapists treat people by prescribing oils that can be inhaled directly, applied to the

skin as part of a massage, or added to a hot bath, in which case the oils are both absorbed and inhaled. Aromatherapy is used to treat infections, pain, arthritis, skin disorders, headaches, digestive disorders, and other conditions.

Although aromatherapy has been used for thousands of years, there is no scientific evidence that it cures any disease. It is critical that patients using aromatherapy (or other alternative medicine) inform their physicians as to what oils, herbs, or supplements they are using to avoid serious complications from drug–drug or drug–herb interactions.

Biomagnetic Therapy

Biomagnetic therapy (also called *magnetic therapy*) involves the use of static magnetic fields or pulsed magnetic fields created by electrical currents to treat a wide variety of ailments, especially pain. Most of the evidence for the effectiveness of biomagnetic therapies comes from testimonials, which do not constitute scientific proof. Magnets may produce benefits by virtue of the placebo effect. Biomagnetic therapies, especially ones using static magnetic fields, do no harm. People spend money on many kinds of health aids to find relief from pain and other problems. Whether money spent on biomagnetic therapies is well spent is a matter of personal experience and belief.

Quackery

Quackery is a term that refers to the sale of useless potions, devices, or other substances that promise to heal or cure the buyer of whatever ails him or her. People (quacks) who sell bogus medical products may actually believe in the products' worth and, consequently, are not committing fraud, which involves knowledge of the worthlessness of the products. Legally, it is difficult to separate quackery and fraud.

Quackery has a long history, and during the 18th and 19th centuries, traveling entertainers sold all sorts of nostrums and

potions in towns all over North America. Some of these potions actually contained “feel good” substances such as opium and cocaine. Quackery in the United States was dealt a serious blow with the passage of the Pure Food and Drug Act in 1906, which made the sale of worthless medicines illegal. The most prevalent fraudulent products listed by the FDA are fraudulent arthritis products, fake cancer clinics, false AIDS cures, penis-enlargement pills and devices, instant weight-loss schemes, fraudulent sexual aids, useless baldness remedies, false nutritional schemes, useless muscle stimulators, and candidiasis hypersensitivity cures.

Why do people buy useless or dangerous health products? Why are people easily fooled by quackery? Perhaps because they believe more in magic than in science (Offit, 2014). If you want to safeguard your health and your pocketbook, you should check on any product or treatment that is not provided by a licensed healthcare provider. A reliable source of information about fraudulent products can be found at www.quackwatch.com.

Critical Thinking About Health

1. Congressman John Fairman has been working on solving the issue of long-term financing of Medicare and Medicaid. His idea is to levy a 10% tax on all cosmetic surgeries that are not done out of medical necessity (such as breast reconstruction after mastectomy). He argues that people who can afford cosmetic surgery can also afford to support the basic medical needs of people less fortunate. If you were a legislator, how would you vote on the congressman's idea? Discuss your reasons.
2. If you're hospitalized for an illness or injury, write a critical description of your experience. What things were the most positive and healing in the hospital? What things were the most distressing and unhealthy about your hospital experience? Based on your own experience, suggest ways that hospitals might improve the care they provide to patients.
3. Joe Windam is in the hospital with liver failure. Joe is only 32 years old but has been a heavy drinker most of his life, just like his father. He also contracted a hepatitis C infection several years ago that has contributed to his liver disease. Joe has been out of work for more than a year and does not have any health insurance. Joe's only hope to live is to have a liver transplant.

Do you think Joe should be given a high priority for a liver transplant because of his young age? Who should pay the several hundred thousand dollars in hospital and doctor bills? There are not enough livers available for all the patients who need them, so how should the priority of liver transplants be assigned?
4. Imagine you experienced a neck injury in an auto collision. After a few months of standard treatment, the orthopedist and physical therapist say you're completely healed, except you still have some pain and difficulty moving your head. Would you consider seeking a treatment that's an alternative to the standard Western medical

approach you had received? Discuss the rationale for your response.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

The Affordable Care Act was designed to help the more than 40 million uninsured Americans pay for health care through insurance. The ACA has been popular with millions of uninsured Americans, especially those with preexisting conditions, who previously could not obtain health insurance. Under the ACA, many low- and moderate-income Americans receive subsidies from the federal government to help pay for their health insurance.

The United States spends twice as much money on health care per citizen compared to any other industrialized country in the world. Most other countries guarantee comprehensive health care for all of their citizens. The United States still has a long way to go to provide affordable, comprehensive health care to all citizens and also to a large noncitizen population.

Everyone requires medical care at some time in their lives. Be prepared with questions when you go to see a doctor and make sure you understand what you need to do to recover. Also, remember that a diagnosis is just one aspect of the patient–physician interaction and treatment options are distinct from the diagnosis. Be wary of unnecessary tests and procedures. Imaging machines are extremely costly, so hospitals and physicians need to use them often to pay for their expense. Always remember that *prevention* is often the best medicine. Immunizations prevent many infections; accidents can be prevented by not taking unwarranted risks and paying attention to what you are doing; overweight and obesity can be prevented by not eating processed foods and sugar-laden sweets and sodas and increasing activity level. Daily vigorous movement helps prevent many chronic illnesses.

The medical care model familiar to most Americans is a science-based Western medicine that seeks to uncover the biochemical, microbial, physiological, neurological, or behavioral cause for

disease and illness. Once a diagnosis is made, a cure is sought using surgery, pharmaceuticals, and psychological and behavioral changes. However, alternative medicines are also widely used around the world as well as in the United States. Hundreds of alternative medicines fall into a few categories: spiritual and mental interventions, nutritional therapies, herbal remedies, and physical and movement therapies. Some of the more widely used alternatives to Western medicine are massage, acupuncture, Ayurveda, and herbal remedies that have been used for thousands of years throughout Asia and Latin America. Some of these alternative medicines have been tested by scientific methods and have proved to be effective for some conditions.

Americans spend billions of dollars every year on vitamin and herbal supplements, energy elixirs, and substances to enhance physical appearance or increase sexual experience. Many of the alternative health products Americans buy produce little or no benefit despite manufacturers' claims. Some products, especially ones manufactured outside North America, may contain pesticides, heavy metals, or other toxic chemicals. Whereas prescription and over-the-counter drugs are regulated by a federal agency (FDA) in the United States, vitamins, herbal supplements, and all products sold in nutritional supplement stores are not. Before you use any unconventional product or device to make yourself feel better, stronger, or happier, investigate carefully whether the product is safe and effective. Do not trust manufacturers' claims without independent verification. Every year, millions of Americans become victims of quackery.

HIGHLIGHTS

- Everyone needs medical care at some time in his or her life. Knowing what to ask and what to expect from your physician and the healthcare system is essential.

- The physician's responsibility is to find the cause of an illness and oversee its treatment. The patient's responsibility is working in partnership with the healthcare provider, sharing in healthcare decision-making, and becoming skilled at obtaining health care.
- Besides physicians, there are a variety of healthcare specialists, some of whom work in conjunction with a person's primary care physician and some of whom work independently, often through physician referral.
- Admission to a hospital is often an unsettling experience. Patients should be aware of their rights and ask questions that will ease their concerns and reduce errors.
- Health care is increasingly provided by large organizations of physicians and hospital, called *preferred provider organizations* or *health maintenance organizations*.
- The Affordable Care Act passed by Congress in 2010 is intended to provide all U.S. citizens with health insurance.
- Healthcare providers include physicians, nurses, physical therapists, occupational therapists, physician assistants, and specialists in sports-related injuries.
- Disparities in health care depend on a patient's sex, race, ethnic origin, or geographical location in the country.
- Organ transplants from live donors are becoming more frequent and pose problems for donors and recipients.
- Medicalization of human behaviors such as smoking, drinking, and overeating has transferred responsibility for the resulting health problems from individuals to physicians. The normal human trait of short stature also has been medicalized.

- Alternative medicine consists of hundreds of methods for dealing with sickness and disease in ways that are different from modern medical care performed by physicians.
- The broad categories of alternative medicine include spiritual and mental therapies, nutritional therapies, herbal remedies, and physical therapies.
- Homeopathy administers highly dilute solutions of substances that are supposed to mimic the symptoms of sick persons and help the body cure itself of the disease.
- Chiropractic and osteopathy use manipulation of the spine and joints to treat musculoskeletal disorders and other diseases.
- Ayurveda and aromatherapy are ancient healing techniques.
- Acupuncture involves inserting extremely thin needles into specific points on the body to restore harmony to the functioning of tissues and organs.
- There is little scientific evidence for the effectiveness of biomagnetic therapy.
- Americans spend hundreds of millions of dollars each year on fraudulent health products and treatments; many of these buyers are victims of quackery.
- Consumers of alternative medicine need to guard against fraudulent claims and unscrupulous persons who advertise therapies of unproved safety and of dubious value.

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KEY TERMS

diagnosis:

the cause of a disease or illness as determined by a physician

health insurance:

a system intended to pay some or all of the costs of a person's medical, surgical, and hospital care

managed care:

systems of health care in which the primary goal is to reduce costs

health maintenance organization (HMO):

an organization (either nonprofit or for-profit) of physicians, hospitals, and support staff that provides medical services to members

preferred provider organization (PPO):

physicians who belong to the organization provide medical care at reduced costs that are negotiated by the organization

magnetic resonance imaging (MRI):

use of a strong magnetic field to produce images of internal parts of the body; especially useful for soft tissues

healthcare disparity:

a higher burden of illness, injury, disability, or mortality experienced by one population group relative to another group

medicalization:

medical treatment of conditions, behaviors, or traits that generally were not regarded as illnesses or medical problems

precision medicine:

tailoring treatments to the genetic makeup of individual patients;
also called *personalized medicine*

cosmetic surgery:

surgery performed not for any medical condition but solely to enhance appearance or correct visible effects of aging

herbal medicines:

materials derived from plants and other organisms that are made into teas, powders, and salves to treat diseases and injuries

alternative medicine:

a therapy or healing procedure that is used *instead of* Western, scientific medical treatments

complementary medicine:

an alternative therapy that is used *along with* conventional medicine.

integrative medicine:

combination of the practice of scientific, Western medicine with alternative medicines that are safe and effective for patients

Ayurveda:

a traditional form of preventive medicine and healing, involving mind, body, and spirit, practiced in India for thousands of years

homeopathy:

an alternative medicine that administers very dilute solutions of substances that mimic the patient's symptoms

chiropractic:

an alternative medicine that uses manipulation of the spine and joints for healing

subluxation:

misalignment of a vertebra from its correct position

osteopathy:

an alternative medicine that uses manipulation and medicines for healing

acupuncture:

an ancient Chinese alternative medicine that uses thin needles inserted into specific points on the body to produce healing energy

meridians:

the channels along the body where energy flows and where acupuncture points are located

naturopathy:

an alternative medicine that uses nutrition, herbs, massage, and other techniques

therapeutic massage:

promotes relaxation and healing by massage of the skin and muscles

aromatherapy:

use of fragrant extracts of plants to promote healing

biomagnetic therapy:

use of magnetic fields to treat pain, ailments, and diseases

quackery:

promotion and sale of unapproved and worthless products, especially for medical problems and health enhancement



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CHAPTER 16

Understanding Aging and Dying



Health Tips

Steps You Can Take to Reduce the Risk of Dementia

Recommendations for Preventing Osteoporosis



Global Wellness

After Childhood and Adulthood There's Oldhood



Managing Stress

Giving Up Driving Is Hard



Wellness Guide

Spice Up Your Mind

Physical Exercise May Slow Aging

Self-Care: Image Visualization

LEARNING OBJECTIVES

1. Describe some of the biological changes that occur with aging.
2. Define *aging*, *maximum life span*, *average life span*, *life expectancy*, *ageism*, and *gerontology*.
3. Discuss some of the health and social issues that stem from the “graying” of the American population.
4. Briefly explain two major theories of aging processes.
5. Explain how undernutrition affects the aging process.
6. Describe some of the symptoms of Alzheimer’s disease and Parkinson’s disease.

7. Describe measures you can take while young to reduce the risk of dementia later in life.
8. Describe some of the causes of vision and hearing loss.
9. Describe several ways to reduce the risk of osteoporosis.
10. Discuss the stages of dying as explained by Kübler-Ross.
11. Explain the role of the two documents that constitute advance directives.
12. Briefly define the terms *physician-assisted suicide*, *hospice*, and *palliative care*.
13. Indicate steps you can take while young to help ensure a healthy old age.

For millennia, humans have fantasized about a magical spring, the waters of which could restore health and youth and postpone the inevitability of death of anyone who bathed in or drank from it. Five hundred years ago, Spanish explorer Ponce de Leon actually sought (and failed to find) a reputed fountain of youth on a Caribbean island. Now the search for an actual fountain of youth has been replaced by the purchase of many billions of dollars' worth of skin creams, vitamins, surgical ("cosmetic") alteration of the body, calorie-restriction diets, storing the body of a newly deceased person (or pet) at an extremely low temperature (*cryopreservation*) until some future time at which the frozen one could be revived, and the creativity and intelligence of many hundreds of scientists throughout the world to reveal and alter the biological forces of aging.

Aging is a collective and gradual change (usually diminishment) in physical form and function over time. As far as we know scientifically, everything in the universe—plants, animals, planets, galaxies, even the universe itself—ages and ultimately decomposes into its constituent atoms. In several billion years, the chemical reactions that power our sun will eventually stop and it will explode and die. Although our planet has existed for 4.5 billion years, natural geological and cosmic forces will lead to its decomposition in another 4.5 billion years. (We hope human forces don't hasten that timeline.)

The cosmic realities of aging and death affect modern humans, too. At this time in galactic history, human **average life expectancy**, the average length of time from birth to death, is about 72 years. The average life expectancy in life-supportive environments is about 10

years longer than the world average but about 20 years shorter in unsupportive environments ([Table 16.1](#)). Since 1980, the average life expectancy in most countries has increased about 10 years from advances in nutrition, sanitation, disease control, and medical care.

TABLE 16.1 | **Average Life Expectancy at Birth in Various Countries**

Country	Average Life Expectancy at Birth
Monaco	89.57
Japan	85.0
Singapore	85.0
Hong Kong	82.9
Israel	82.4
Monaco	89.4
Japan	84.7
Hong Kong	83.4
Canada	83.6
United Kingdom	81.3
United States	80.4
Kuwait	78.0
Mexico	76.9
China	76.3
Iran	75.1

Country	Average Life Expectancy at Birth
Russia	72.1
India	68.5
Kenya	64.0
South Africa	63.1
Afghanistan	51.3
Chad	50.2

Data from U.S. Central Intelligence Agency. (2020). Country comparisons: Life expectancy at birth. World Fact Book. <https://www.cia.gov/the-world-factbook/field/life-expectancy-at-birth/>

Several countries in the world have populations with average life expectancy above 80 years, which approaches the maximum average life expectancy for human beings. However, many other countries have populations whose average life expectancies are 55 years or less. This one statistic shows the tremendous inequality in health and opportunity that people experience from birth. Among the 226 countries for which data are available, the United States ranks 46th in average life expectancy. The average life expectancy at birth in the United States has increased by 30 years since 1900.

I don't want to achieve immortality through my work. I want to achieve immortality by not dying.

—Woody Allen

Currently, it appears that the longest humans can possibly live, called the **maximum human life span**, is about 120 years. The oldest person whose age has been reliably documented is Jeanne

Calment, who died in Arles, France, at age 122 on August 4, 1997. As of this writing in mid-2021, the oldest living person is Kane Tanaka, age 118, who was born on January 2, 1903. Although the number of people living past age 100—a group known as the *oldest old*—is rapidly increasing, studies in Scandinavia suggest that in the absence of disease, death from old age could occur as late as 110 years. However, whether the maximum life expectancy for most people in the absence of disease is 85, 100, or 110 years, it nevertheless appears that the human maximum life span is 120 years or so. No human being is going to live to be as old as Methuselah, the biblical patriarch who is said to have lived for 967 years.

Causes of Aging

That there is a maximum life span suggests that predetermined biological or genetic factors play a significant role in the aging process. Considerable scientific research suggests that two major biological forces are responsible for aging and subsequent death: (1) biological (genetic) mechanisms that predetermine the possible length of life (maximum life span) and (2) physical damage (“wear and tear”) to cells and organs that results in dysfunction and disease leading to diminished and eventual collapse of biological function. Of the 150,000 people in the world who die each day, about 35% die of “old age” (biologically predetermined life span) and the others die of recognizable diseases, which often are the result of environmental assaults that induce cumulative damage at various levels of the maintenance, repair, and defense of bodily functions.

Evidence for a biological predetermination of the life span comes from the study of cells and tissues maintained in a laboratory container. Almost all cells come into existence by the reproduction of progenitor cells. These experiments showed that progenitor cells can reproduce only a fixed number of times and then die. The number of reproductive cycles is related to the maximum life span of the animal from which the cells were taken. Mouse cells only divide a few times, but human cells divide many times before dying. The inescapable conclusion from these experiments is that built into the cells of every animal is a genetically controlled “clock” that determines how many times cells divide before some mechanism makes them stop.

Another demonstration of an inherent determinant of aging is the shortening of **telomeres**, which are small segments of DNA at the ends of chromosomes in every cell. It's the role of telomeres to protect functional integrity of the DNA when a cell divides. But in so doing, telomeres become a bit shorter. In early life, telomeres are long. Over time and cycles of cell division, telomeres progressively shorten until they cannot protect chromosomes well or at all. This

results in cell malfunction (*cell* senescence) or cell death. Some inherited conditions involving premature aging are associated with malfunctions in telomere biology.

Genetic variants in certain animals such as worms and flies, either discovered in nature or induced experimentally, have produced individuals that live about twice as long as average for their species. Such long-lived worms and flies are healthy and active even as they pass the age at which individuals in their species normally die. Many scientists (and the private drug companies that support their work) hope to find gene variants that would extend the life span in humans and domesticated and agriculturally useful animals.

Another example of the biological predetermination of the life span is that average life expectancy cannot be increased significantly by curing the major causes of death such as heart disease and cancer. Complete elimination of one or even both of these diseases would add only a few years to the average life expectancy after age 50 (**Figure 16.1**). Although curing major diseases is of inestimable benefit to those who die prematurely from them, their elimination has only a small effect on the average life expectancy.

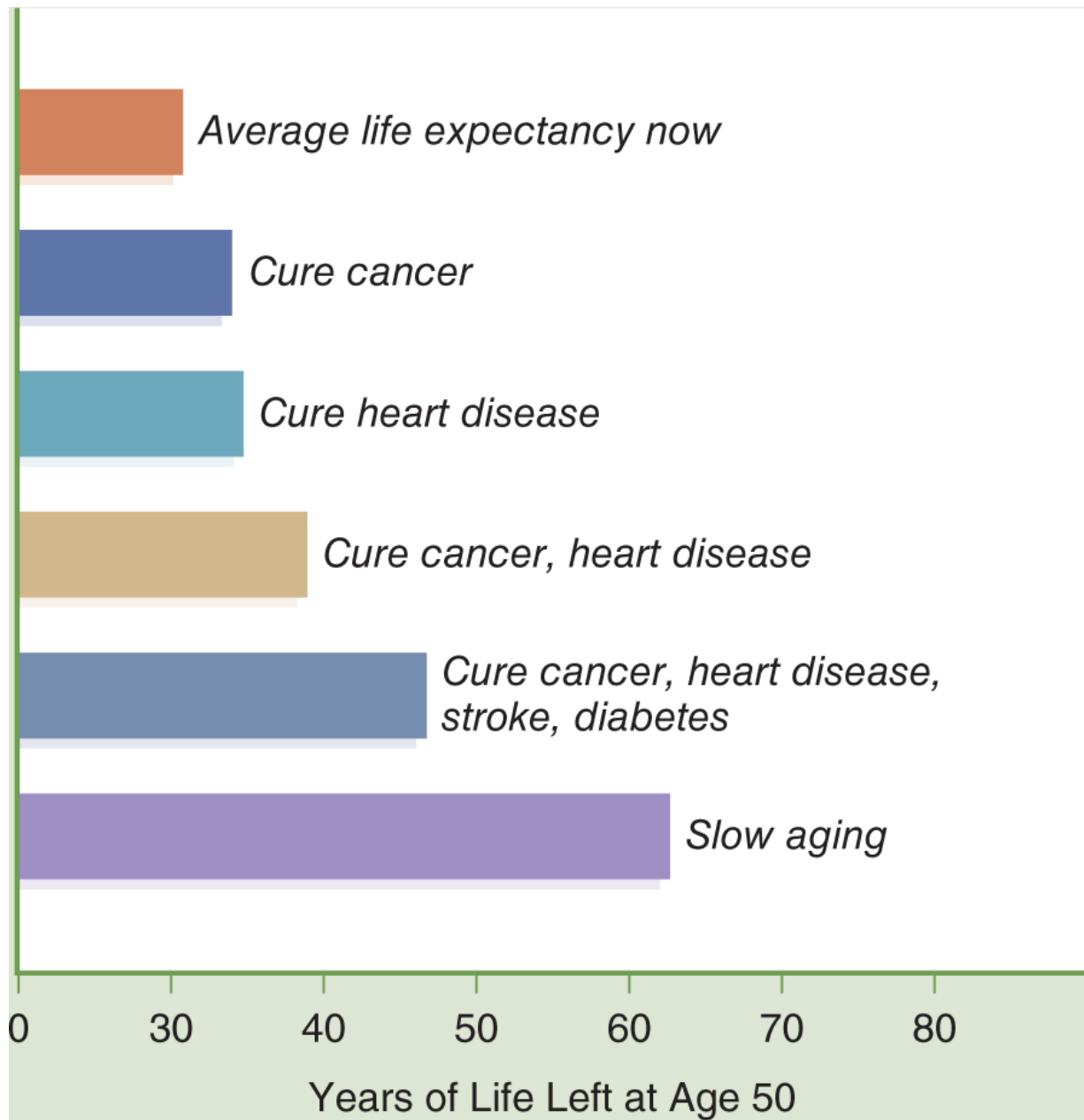


Figure 16.1 Increase in Average Life Expectancy After Age 50 Resulting from Curing Major Diseases or from Slowing Aging Processes. Eliminating cancer or heart disease as causes of death adds only a few years to the average life expectancy of the U.S population. However, if ways could be found to slow the biologically predetermined aging processes, life could be extended.

Description



Shared activities are healthful at any age.

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Giving Up Driving Is Hard

One of the hardest things for older people to do is give up driving. Driving a car is a sign of independence; being able to come and go as one pleases. Having to stop driving means becoming more dependent on other people and signifies the diminishment of life because of age. Even if a person is basically healthy, driving skills tend to decline with age, as evidenced by these signs:

- Do I get nervous at intersections or when making left turns?
- Do I have trouble scanning far down the road to anticipate problems?
- Do I fail to notice red lights or traffic signs?
- Do cars suddenly seem to come out of nowhere?
- Do I generally feel nervous while driving?
- Do I have trouble looking over my shoulder when changing lanes?
- Do I have trouble seeing the sides of the road when looking straight ahead?
- Have I had a “close call” while driving in the past 6 months?

Many people associate aging with sickness, disability, loneliness, and increased inactivity. However, such negative views of aging are exaggerated; many older persons today are mentally, sexually, and physically active and continue to work well into their 80s or even 90s. The normal processes of aging are not caused by disease, so aging cannot be cured.

Besides inherent biological changes, aging results from wear and tear on organs, bones, and tissues in the body that change and become less efficient over the years: Muscles weaken, immune system functions decrease, and hormone-supported sex drive is reduced. Even the healthiest body wears out slowly. Although they play a significant role in aging processes, the genes one inherits from one's parents account for less than half of the differences in life span among individuals. Identical twins who share identical genes generally die at quite different ages.

Also, because of disease, accidents, and other factors, actual populations do not survive according to the situation predicted but have followed various paths throughout history (**Figure 16.2**).

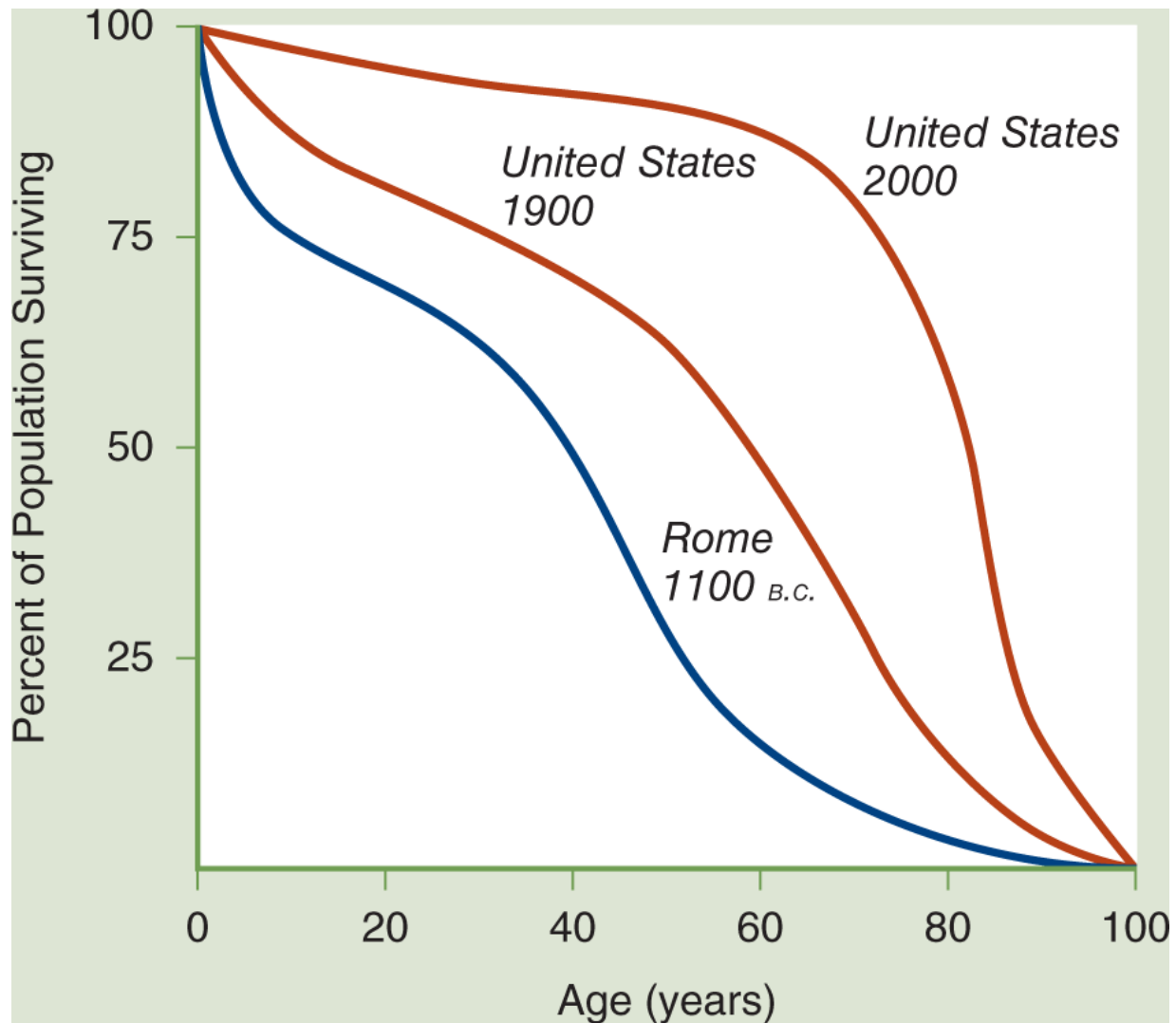


Figure 16.2 Approximate Survival Curves for Various Populations. The U.S population is beginning to approximate the idealized curve.

Description

The *graying* of America has caused social, medical, and economic problems. First and most important is the ability of the federal government to sustain Social Security payments in the future. At the current rate, the government has estimated that the Social Security system will run out of money within 30 to 40 years. To avoid this, Congress has begun to discuss ways to reform Social Security so that future retirees still will receive benefits. Although many older people are vigorous and healthy, a large number of people over age 65 have chronic illnesses and disabilities that require ongoing

medical care, and some need expensive long-term care. About 80% of older Americans have at least one serious chronic medical condition; about 20% have five or more chronic conditions. As more and more people live longer, the costs of health care for the elderly will continue to increase.



Many people continue to enjoy work long after the “normal” retirement age.

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The average life expectancy at birth for all Americans is about 78 years, but there are significant differences between the sexes and races that result from biology, socioeconomic factors, education, and access to health care. For example, White women outlive White men by about 5 years. The average difference in life expectancy between Black Americans and White Americans is about 4 years. Studies suggest that socioeconomic factors are the strongest predictor. The

lower a person is on a socioeconomic scale, the greater are his or her health problems and the lower the life expectancy.

Environmental Factors in Aging

Although genetic factors contribute to aging, environmental factors also play a role. The longer a person lives, the more they are exposed to radiation and chemicals that can damage DNA in cells and cause tissues and organs to malfunction over time. Most cells possess systems that repair damage to their DNA. But when the DNA that controls the structure and function of these cellular repair systems gets damaged by environmental influences, DNA repair in all cells can malfunction, which could lead to accelerated aging and death. This is the *error catastrophe* theory of aging. Accumulated damage to DNA in any kind of cell may be responsible for development of cancer, which itself can shorten life span.

Another effect of exposure to radiation and chemicals is the production of highly reactive molecules called **free radicals**. These substances are normally inactivated by our cells, but as we age they generally become less able to cope with the damaging effects of free radicals. Free radicals also increase the damage to mitochondria, the complex structures in all cells that provide the energy for cellular growth and function. Without sufficient energy, cells become weak and possibly die; if too many cells die, organs function less efficiently and the person ages more rapidly. The *mitochondrial error theory of aging* is supported by animal studies. Mice have been genetically engineered so that the mitochondria in their cells rapidly accumulate genetic damage. These genetic variants adversely affect essential mitochondrial functions. These mice age prematurely and die young.

Immune system functions also become less efficient with age so that we become more susceptible to infections and diseases. Overall, aging is a complicated process brought on by a combination of genetic and environmental factors.

Neurodegenerative Diseases

Alzheimer's Disease and Senile Dementia

In the absence of disease, normal mental functions can be maintained to age 100 or longer. However, many of the elderly have some loss of normal cognitive functions. The medical term for impairment or loss of cognitive functions in elderly persons is **senile dementia**.

The symptoms of senile dementia include the following:

- Loss of memory that increases over time
- Feeling confused
- Loss of problem-solving skills
- Suffering from delusions and agitated behavior
- Becoming lost in familiar settings
- Loss of interest in daily activities.

Many medical conditions can cause dementia. A common cause is small strokes (damaged brain blood vessels) that gradually destroy cognitive functions. Neurodegenerative diseases such as Parkinson's disease, Huntington's disease, and Alzheimer's disease also cause dementia. In addition, viral and bacterial infections that cause HIV/AIDS, syphilis, tuberculosis, and meningitis also can give rise to symptoms of dementia.

The most common cause of dementia in the elderly is **Alzheimer's disease (AD)**, which accounts for more than half of all cases of dementia. AD is caused by damage to neurons in the brain, resulting in loss of cognitive functions, memory, mobility, and eventually death. Currently, more than 5 million Americans suffer from AD; worldwide there are an estimated 35 million cases. Late-onset AD usually is diagnosed after age 65, but the frequency of AD

increases rapidly with age (**Figure 16.3**). By midcentury, it is estimated that 14 million Americans will have AD; worldwide the number is predicted to be in excess of 106 million people.

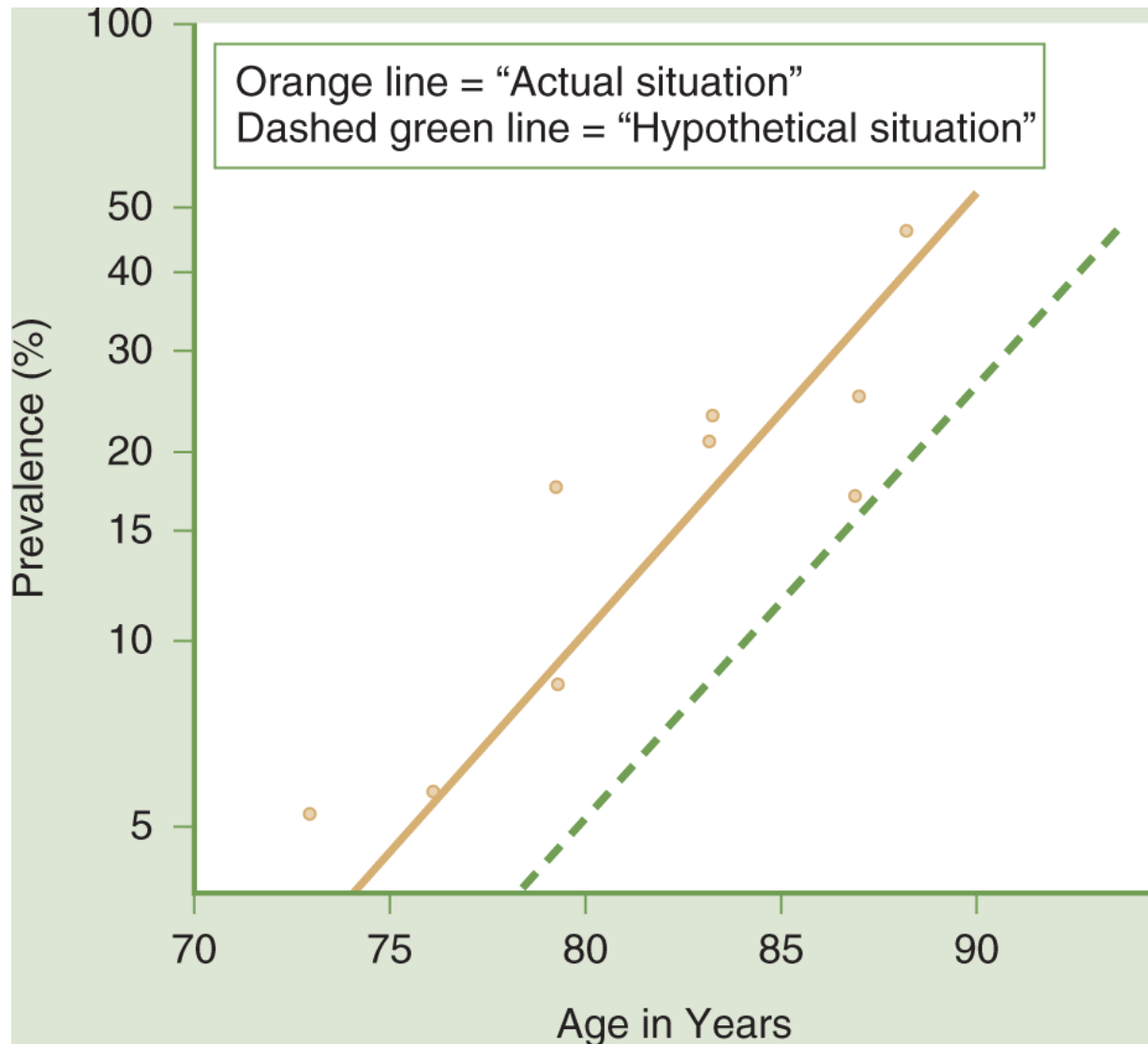


Figure 16.3 Benefits of Slowing Onset of Alzheimer's Disease. Alzheimer's disease (AD) increases linearly with age (orange line). The graph shows that if the onset of AD were delayed 5 years by a drug or other intervention, in this case from age 73 to 78, the prevalence of AD would decrease by half (dashed green line). This hypothetical reduction in the number of people with dementia would be an enormous benefit to families and society and would also substantially reduce health costs.

Courtesy Robert Katzman, University of California, San Diego.

Description

The disease is named for Alois Alzheimer, a German physician. In 1907, he described the abnormal brain structures he observed under the microscope in tissues obtained from people who died from senile dementia. Alzheimer's findings at autopsy revealed what are still the diagnostic criteria for the disease: (1) the presence of bundles of tangled nerve fibrils called **tau tangles** in certain areas of the brain and (2) the presence of plaques made of **amyloid protein**, which is localized in certain areas and blood vessels of the brain. How these changes affect the brain to produce loss of cognitive functions is still not understood.

Two forms of Alzheimer's disease are recognized: familial AD and sporadic AD. Familial AD, also known as early-onset AD, is a rare form of the disease that develops in individuals by age 50. This form has a strong genetic basis and often occurs in families in which many members suffer from AD at an early age.

A large, unique family in Colombia has been found in which dozens of family members develop Alzheimer's disease by age 50. A single abnormal dominant gene inherited from either parent is sufficient to cause early-onset AD among this group. By studying this gene and other genes causing the familial form of AD, scientists hope to understand what causes late-onset (sporadic) AD, which is the form that occurs in almost 99% of cases. Inheriting one copy of a gene called APOE increases the risk of sporadic AD by a factor of 4; inheriting two copies of the gene, one from each parent, increases the risk 10-fold. A genetic test for this gene is available so individuals can find out if they are at higher-than-average risk of having AD in later life. However, finding out that you carry an APOE gene may cause a lot of worry, so anyone planning to take such a test must first undergo genetic counseling.



Dementia

Steps You Can Take to Reduce the Risk of

Generally speaking, actions that promote good health also reduce the risk of Alzheimer's disease and other forms of dementia later in life. Some research supports the following risk-reduction strategies.

Physical exercise: Moderate exercise such as walking several times a week.

Omega-3 fatty acids: Consuming more of these fatty acids that are found in fish.

Mental activity: Staying mentally active, even doing crossword puzzles or playing challenging games such as chess.

Healthy diet: Eating healthfully; maintaining normal weight.

Blood pressure: Maintain normal blood pressure; 130/80 mm Hg.

The sporadic form of AD may be caused by environmental factors that are undetermined as yet. The primary risk for sporadic AD is age. After diagnosis, AD can progress rapidly or slowly; the average time until death after diagnosis is 3 to 10 years.

Several drugs have been approved for treating the memory and cognitive losses that accompany Alzheimer's disease. Three of the drugs are known as *cholinesterase inhibitors*: donepezil (Aricept), rivastigmine (Exelon), and galantamine (Razadyne). The other approved drug, memantine (Namenda), blocks the attachment of a specific neurotransmitter to cells. Clinical trials showed a modest effect on symptoms of patients with moderate dementia, and only a minority of patients benefited at all. As one physician observed, "You can name 11 fruits in a minute instead of 10. Is that worth 120 bucks a month?" Still, many family members, caregivers, and physicians who are desperate to do something to slow the ravages of Alzheimer's disease are willing to pay the price. As AD progresses and behaviors become more agitated, antipsychotic drugs often are prescribed.

Until recently, AD could be confirmed only after death by examining the deceased person's brain for the presence of amyloid plaques. Now, a brain scan test (Amyvid test) is available that can confirm the amount of amyloid plaques in the brain of someone suspected of having AD. However, the test is only recommended for patients who already exhibit loss of memory and cognitive function.

Because a diagnosis of AD has profound consequences for patients and their families, a well person should think long and hard before undergoing such a brain scan.



Spice Up Your Mind

Curry is a staple component of food in India and other Asian and Middle Eastern countries. The spice that gives curry its main aroma, flavor, and color is turmeric. Recently, scientists have discovered that a particular chemical in turmeric called *curcumin* may be effective in preventing and treating Alzheimer's disease.

In Pennsylvania, the prevalence of Alzheimer's disease among persons aged 65 and older is 17.5 per 1,000 individuals; in southern India where curry dishes are eaten daily, the prevalence is 4.7 per 1,000 individuals (Barry, 2007).

In the laboratory, adding curcumin to cells that contain amyloid protein plaques (found in the brains of Alzheimer's patients after death) rids the cells of the harmful protein. The evidence is thus building that curcumin really does have therapeutic potential for treating Alzheimer's disease. One problem with consuming curcumin in food or tablets is that the chemical does not easily enter the brain. Research shows that curcumin can be attached to nanoparticles to facilitate entry of the chemical into the brain. Mice with symptoms of memory loss and amyloid plaques in the brain show some improvement with this experimental treatment.

Taking curcumin as a supplement is not advised because dietary supplements are not regulated or tested for purity. Eating more curry dishes may be a good idea. Stick with yellow curry powder, which contains more turmeric than red curry powder.

Epidemiological studies show that people with more education (college graduates) are much less likely to develop Alzheimer's disease than people with little or no education. A study of Catholic nuns who died between ages 76 and 100 has confirmed the importance of education. All of these Catholic nuns were college-educated and had a much lower prevalence of Alzheimer's disease than the general population. And among the few who did develop the disease, it could be shown by studying their brains after death that stroke was a primary trigger of the clinical symptoms of Alzheimer's disease.

It is not simply the level of education that helps to prevent the development of Alzheimer's disease. The key is to use the brain throughout life. Keep learning new things and exploring new ventures—even doing crossword puzzles may help. It is now clear that brain cells continue to grow and establish new connections throughout life and that brain growth and health are dependent on mental stimulation. Just as exercise is necessary to maintain the body's fitness at all ages, exercising the brain is necessary to maintain mental functions (Marx, 2005).

Parkinson's Disease

Parkinson's disease (PD) is the second most common cause of neurodegenerative disease (after Alzheimer's disease) among older persons. About 1 million Americans suffer from PD, and about 60,000 new cases are diagnosed every year. Like other major neurological diseases such as Alzheimer's or *amyotrophic lateral sclerosis* (ALS), generally referred to as Lou Gehrig's disease, Parkinson's disease is chronic and progressively worsens despite treatments that alleviate symptoms. PD was first described in 1817 by an English physician, James Parkinson, who described the symptoms as "the shaking palsy."

PD has four defining symptoms.

- *Tremor*: The tremor of a person suffering from PD involves a rhythmic back-and-forth motion of the thumb and forefinger that appears as if the patient is rolling a pill between the fingers. Although the tremor usually is observed in a hand, it can also arise in a foot or in the jaw.
- *Rigidity*: A basic principle of all movements of the body is that all muscles have opposing muscles. Movement occurs when one set of muscles contracts and the opposite set relaxes. The signals that tighten or relax muscles originate in the brain and

are transmitted automatically to the muscles so that we make the movement that we desire. In PD, the signals from the brain are not coordinated, and the delicate balance between muscle tension and muscle relaxation is lost. In PD, the muscles stay constantly tensed and contracted, causing stiff and achy muscles.

- *Bradykinesia*: This is probably the most distressing symptom of PD. *Bradykinesia* refers to the slowing down and loss of spontaneous movement. One moment, a person with PD is moving normally—crossing a street, for example—the next moment, that person is frozen and cannot move, possibly in the middle of the crosswalk. Daily activities such as washing or putting on clothes may take hours because routine movements cannot be performed rapidly or continuously.
- *Postural instability*: People with PD have impaired balance and coordination of movements, so they develop a tendency to lean forward or backward and to fall easily. As the disease progresses, walking becomes increasingly difficult; a patient may freeze in midstep and topple over if someone is not there for support.

PD is usually treated with the drug L-dopa (l-3,4-dihydroxyphenylalanine) as it delays the onset of PD symptoms for a period of time. Not all people with PD are helped to the same degree by L-dopa, and not all symptoms of PD improve to the same degree. Often, L-dopa is taken with another drug, carbidopa (Lodosyn); this reduces the dose of L-dopa needed and increases its effectiveness. Unfortunately, the effectiveness of L-dopa therapy, in combination with other drugs, diminishes as the disease progresses. Neuroscientists are actively searching for new drugs to halt the loss

of dopamine neurons in the brain and ways to replace malfunctioning neurons by transplantation or genetic alteration.

As with other neurodegenerative diseases, the causes of PD are both genetic and environmental. Several genes are linked to rare, inherited (familial) forms of PD, and numerous other genes are involved in the development of sporadic (not inherited) cases of PD. It is possible that the proteins produced by all of the genes associated with neurodegenerative diseases (AD, PD, ALS) change shape as people age, presumably as the result of time or exposure to environmental factors or both (Prusiner, 2012). As these altered proteins accumulate in the brain, they cause the normal proteins also to change. The altered proteins accumulate and form the plaques that are diagnostic of a neurodegenerative disease. These plaques can now be visualized using brain scan tests.

However, environmental factors such as exposure to pesticides and other chemicals that affect the functions of mitochondria, the energy-generating organelles in cells, also can result in PD. Studies with mice have shown that blocking mitochondrial functions with a specific chemical can cause the mice to develop symptoms that mimic those of PD. These preliminary results should further alert people to the potential serious, long-term dangers of pesticide exposure.

Osteoporosis

The skeleton provides a means of locomotion, protection of vital organs, and a readily available store of calcium and phosphorus. Only recently has it been recognized that the skeleton is a delicately balanced regenerating tissue, regulated as precisely as the body's destruction and manufacture of blood cells. The most common metabolic bone disease is **osteoporosis**, which results from many environmental factors such as poor diet, smoking, corticosteroid use, excess alcohol consumption, and lack of exercise. Genetic variation among individuals also may be an important factor in the development of osteoporosis in some individuals, but not others.

Osteoporosis occurs because the rate of bone breakdown exceeds the rate of bone renewal; many factors contribute to this. In older women, estrogen loss following menopause contributes to loss of bone material. In both older men and women, aging results in bone loss and increases the risk of fracture, depending on how much bone mass is reduced. Generally, the bone loss in women caused by low estrogen levels is significantly greater than the bone loss caused by normal aging processes.

The risk of osteoporosis in older women can be lessened by replacing the lost estrogen with **hormone replacement therapy (HRT)**. Although many women benefited from HRT, some studies showing that HRT increases slightly the risks of heart attack, stroke, and breast cancer have persuaded many postmenopausal women to forgo HRT therapy. On the other hand, other studies show that extremely low doses of estrogen may help prevent osteoporosis while avoiding the risks of standard HRT therapy. Estrogen supplementation in postmenopausal women also reduces the risk of Alzheimer's disease by about half. Thus, the use of HRT or low-dose estrogen may benefit some postmenopausal women. Making an informed decision is difficult, but discussing all options with one's health provider is important.

The best way to avoid osteoporosis is to build up as much bone mass as possible while young through a healthy diet with sufficient calcium, vitamin D, and exercise. Only 10% of American children get enough calcium or vitamin D or exercise enough to prevent osteoporosis later in life. Even children can be diagnosed with low bone mass that will only worsen as time goes on. After maturity, calcium and vitamin D still are needed to maintain bone mass. Consuming at least a gram of calcium daily is recommended, but nutritional surveys indicate that half of all Americans do not consume that amount. Vitamin D is essential because it assists in the absorption of dietary calcium and in bone formation. Milk is advocated as the best bone-building food. It contains large amounts of calcium and is fortified with vitamin D to facilitate calcium absorption.

Osteoporosis can be treated in two different ways. Either the breakdown of bone can be slowed or the synthesis of new bone can be accelerated. In principle, both mechanisms can be treated with drugs, but in practice only one or the other is effective, not both. The class of drugs that reduces bone breakdown (also called *remodeling* or *bone resorption*) is bisphosphonates. These drugs have proved effective and result in an increase in bone mass in postmenopausal women by about 1% per year. The drug that stimulates new bone formation is a fragment of the parathyroid hormone. This drug can increase bone mass by as much as 10% in a year, but it has some drawbacks. It must be taken daily, there are risks of side effects, and the regained bone mass is lost when the therapy is stopped. The first bisphosphonate to treat osteoporosis, alendronate (Fosamax), was introduced in 1995. Since then, three other bisphosphonate drugs have been approved to treat osteoporosis. Generally, these drugs have been proven safe and effective, and millions of women have used them to prevent and treat osteoporosis. However, they can cause a rare kind of fracture of the thigh bone without any stress or injury. Because of this risk, women are advised to be more cautious in using bisphosphonates.



Regular exercise is important for reducing the risk of osteoporosis.

© Johner Images/Getty Images



Recommendations for Preventing Osteoporosis

- Be sure you are getting the recommended daily amounts of calcium and vitamin D. High levels of calcium are found in milk, leafy green vegetables, soybean products, and cheese. Vitamin D is synthesized in the skin by sunlight exposure. People getting insufficient amounts of these substances should take supplements.
- The average adult younger than age 50 needs about 1 gram of calcium per day and 200 International Units (IUs) of vitamin D. One cup of fortified milk provides 302 milligrams of calcium and 50 IU of vitamin D.
- Adults should maintain a healthy weight and exercise at least 30 minutes daily. Weight-bearing and balance exercises also are recommended.
- Do not smoke.
- Take steps to reduce the risk of falls at home, at play, and at work.

More about bone health from the U.S. National Institutes of health:
<https://www.bones.nih.gov/>

Currently, 14 million Americans older than age 50 are affected with osteoporosis, and with the aging population increasing, millions more are at risk. Currently, osteoporosis is the cause of more than 1 million fractures every year in people older than age 50. The most frequent kinds of fractures are:

- Hip fractures—300,000
- Vertebrae fractures—250,000
- Wrist fractures—250,000
- Other bone fractures—300,000.

About 20% of senior citizens who have a hip fracture die from complications of the fracture; another 20% wind up in a nursing home.

Young, active people have difficulty thinking about building up their bone mass while young. However, a healthy diet consisting of green leafy vegetables and milk (not soda) and lots of exercise will go a long way toward keeping your body strong and active later in life.

Age-Related Vision Loss

The prevalence of blindness and vision impairment increases rapidly with age among all racial and ethnic groups, particularly among people older than 75 years. When combined with chronic health conditions such as diabetes, vision loss is associated with overall poorer health among people 65 and older. Vision loss compromises people's quality of life because it reduces their capacity to read, drive a car, watch television, or keep personal accounts. Often, it isolates older people and keeps them from friends and family. Direct medical expenses for older adults with vision impairments cost the United States \$8.3 billion a year.

As people age, changes may occur in the pupil and macula of the eye that affect vision (**Figure 16.4**). Because of changes in the proteins making up the lens of the eye, the lens may become cloudy with *cataracts*. Normal vision can be restored by surgically replacing a cloudy lens with a plastic lens. If cells in the macula begin to die, a more serious condition called **age-related macular degeneration (AMD)** results. Once AMD starts, it gradually worsens over time. There is no treatment or way to prevent AMD. Although people with AMD have increasing difficulty seeing things, they usually do not become completely blind.

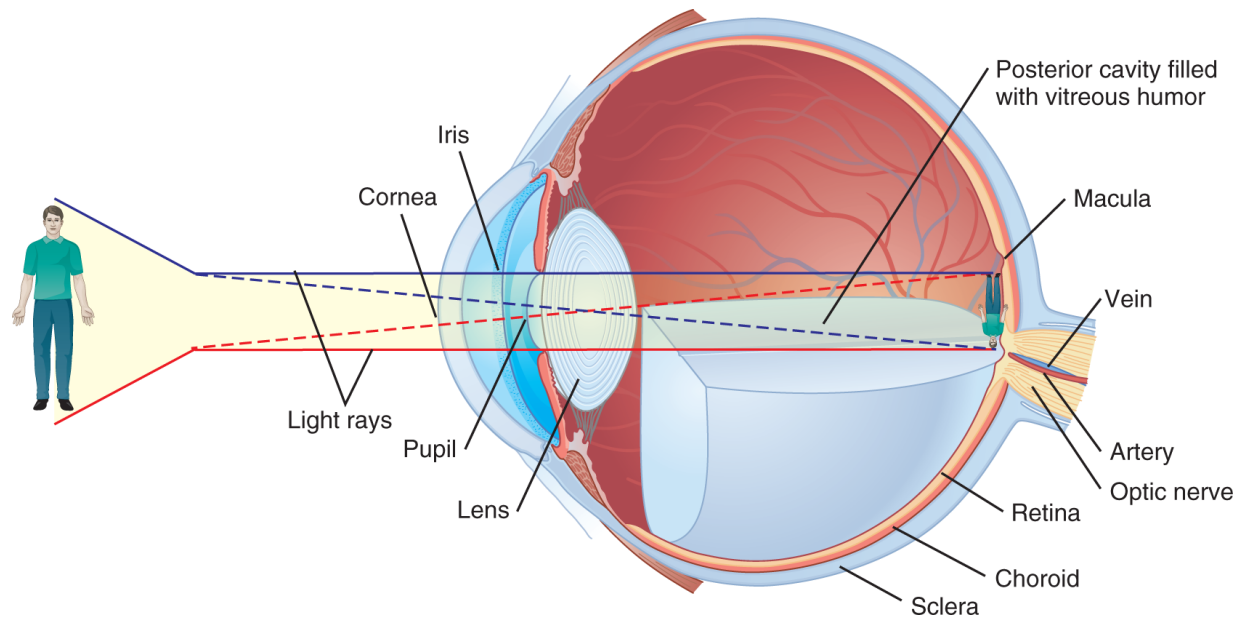


Figure 16.4 The Human Eye. Common types of vision loss as people age are cloudiness of the lens (*cataracts*) and narrowing of the field of vision from degeneration of the macula (*age-related macular degeneration*).

Description

Smoking, high blood pressure, diabetes, and injury can contribute to vision loss. Regular professional eye care, healthy nutrition, increased physical activity, and positive lifestyle choices can help the elderly maintain their vision and slow any age-related loss.

Age-Related Hearing Loss

Hearing loss is the third most common chronic health condition among older Americans after high blood pressure and arthritis. About 4 million Americans older than 65 have **age-related hearing loss** and difficulty understanding normal conversations. Some age-related hearing loss is inevitable as sensitive cells of the inner ear die or become less functional. However, much hearing loss is caused by exposure to noise and is referred to as *noise-induced hearing loss*. Even a single exposure to an extremely loud noise such as an explosion or a blast of sound from a loudspeaker can produce some permanent hearing loss. Lifetime exposure to loud noises such as driving in urban traffic, using power tools, listening to loud music, and working in noisy factories may also result in a gradual but permanent hearing loss.

Protecting your hearing while young is essential to preserving as much hearing as possible when you become old. Avoid explosions from firecrackers and guns or take precautions to protect your hearing. Always wear ear plugs or earmuffs designed to reduce environmental noise when operating any kind of noisy equipment. Even vacuum cleaners and hair dryers may exceed safe noise levels. Your hearing is precious; protect it at all times.



Physical Exercise May Slow Aging

Physical exercise has long been recommended for older people to help them remain physically fit, prevent weight gain, and enhance balance to prevent falls. In addition to maintaining physical vigor, exercise may actually have a beneficial effect on the structural integrity of chromosomes. Structures at the ends of chromosomes called *telomeres* are responsible for preventing the loss of genes near the ends each time a chromosome duplicates.

Telomeres wear away little by little as we age; if telomeres become too short, cells die. If too many cells die, organs fail and we may die. Scientists have examined the length of telomeres in cells taken from older people who exercised and from people who were sedentary. The most active people had telomeres that were considerably longer than ones from people who did not exercise at all (Ludlow et al., 2013). The conclusion of the study was that exercise may slow aging by preventing chromosome destruction and consequent death of cells in the body.

Thinking About Aging

When you are young, thinking about aging usually is the last thing on your mind. You look at your parents and grandparents and cannot really imagine what it feels like to be 60 or 80 years old. Aging is something that happens to everyone irrespective of how successful they have been in living a “healthy” life. Of course, efforts that are implemented while you are young to care for your physical, emotional, mental, and spiritual health will help maintain well-being when you are old. But there is no guarantee. Things happen. Life is a journey. Nothing in life is predictable. The main thing is to have the resiliency, understanding, and spiritual strength to cope with changes.

Acceptance of change is crucial to “successful” aging. When you get older, physical strength may diminish, but hopefully you no longer need to lift heavy objects. You walk more instead of being “on the run.” Having time to cook at home and being able to enjoy fresh foods are daily pleasures. You have time to read, think, and meditate. You have more time for art, gardening, reading, exercise, and socializing. Small things like watching a full moon rise from the ocean are special events. You are more aware of the spiritual side of nature and people.

Health and aging are lifelong processes, not goals that can be set and achieved with concentrated effort. At any age, you can take steps to improve your health now and later in life.

End-of-Life Decisions

With few exceptions, the media portray aging as a time of life beset with sickness, inactivity, and deterioration of physical, sexual, and mental functions. These negative views of aging are used to sell products and do not truthfully portray the experiences of most older Americans.

I don't mind dying. . . . I just don't want to be there when it happens.

—Woody Allen

Of all human fears, for most people, none is greater than the fear of death. When we are young, thoughts of death and dying are rare. Instead we are occupied with living, learning, and daily activities. We can't imagine that someday we will die. As we grow older and see parents, relatives, and friends die, we become more aware of our own mortality. We may begin to ponder our own eventual death.

Fear of aging and death may lead to anxiety and stress that may hasten aging processes. A few of the many fears that people associate with aging are cancer, poverty, being victimized, becoming disabled, memory loss, and sexual inadequacy. Most of these fears are unfounded, but they diminish quality of life. Chronological age often does not correlate with biological age. Some people feel and act young even if old.

Steve Jobs, the former head of Apple Computer and Pixar Animation Studios, was diagnosed with terminal pancreatic cancer in 2004 and died in 2011 at age 56. In an eloquent address to the Stanford University graduation class, Jobs described what this experience did for him.

Remembering that I'll be dead soon is the most important tool I've ever encountered to help me make the big choices in life. Because almost everything—all external expectations, all pride, all fear of embarrassment or failure—these things just fall away in the face of death, leaving only what is truly important. Remembering that you are going to die is the best way I know to avoid the trap of thinking you have something to lose. (Jobs, 2005)

Most people would prefer to die peacefully in their sleep after living a full, satisfying life. Some may be fortunate to die like this, but others may have to endure considerable pain and suffering for years. In addition to wondering how they are going to die; people usually wonder what will happen to them after death. Christianity provides a heaven where one's "soul" can exist in the grace of God for all eternity. Buddhism embraces a belief in reincarnation; after a series of deaths and rebirths a person can attain *Buddhahood*, a perpetual state of enlightenment.

In our society, death is not discussed openly, although this is beginning to change. Dying people are often isolated in hospitals, and their care is left to physicians who may perform unwanted or unnecessary treatments. Sterile, impersonal death in a hospital or nursing home has increased many people's fears of death and the process of dying.

Stages of Dying

People have different attitudes toward death and dying. In conversations with many persons who were facing death, Elisabeth Kübler-Ross (1975) identified five distinct stages in the process of dying. Not all persons experienced all stages, but most experienced some of them. These stages of dying are (1) denial and isolation, (2) anger, (3) bargaining, (4) depression, and (5) acceptance.

The work of Kübler-Ross has found widespread acceptance, especially among counselors and those who help dying patients, but it has also been criticized. The main objection is that the studies were not conducted scientifically but were based on personal observation and interpretation. Another criticism is that because the stages of dying that Kübler-Ross proposed have been widely

accepted and publicized, some dying patients may feel obliged to follow the stages she described.

More and more it is recognized that dying, like living, is an individual, personal matter. People can do as poet Dylan Thomas recommended and “Rage, rage against the dying of the light.” Or they can embrace the idea that “with a better understanding of aging, it will become easier to accept the fact that life ends” (Campion, 1998).

Advance Directives

In 2005, the widely publicized case of Terri Schiavo created a national controversy. On February 25, 1990, Terri Schiavo suffered a heart attack that was triggered by complications of an eating disorder. The heart attack interrupted the flow of blood to her brain. Although medical intervention kept her alive, she suffered extensive, permanent brain damage and survived in what is medically described as a *persistent vegetative state*, a condition in which no detectable cognitive brain function remains.

Terri Schiavo was kept alive for 15 years by means of a feeding tube that supplied nutrition and water. Her husband, Michael Schiavo, insisted that his wife would not have wanted to be kept alive in this way and wanted the feeding tube removed. Terri Schiavo’s parents were adamantly opposed to this action and insisted that their daughter be kept alive by any and all means. The battle over Terri Schiavo ultimately involved the governor and legislature of the state of Florida, the U.S. Congress, the Supreme Court, and President George W. Bush (Bloche, 2005). In the end, the courts allowed the feeding tube to be removed and Terri Schiavo died on March 31, 2005 (Annas, 2005).

The Terri Schiavo case made millions of Americans realize the importance of executing **advance directives** so that family and health providers know exactly what their wishes were regarding medical care should they become unable to function on their own behalf. Advance directives are particularly important for the elderly

but should be executed by young people as well. Terri Schiavo was only 26 when she suffered her heart attack.

Advance directives typically consist of two distinct documents. A **living will** explicitly states your desires for or rejection of specific treatments should you become unable to communicate. A living will should indicate your wishes with respect to artificial ventilation, cardiopulmonary resuscitation (CPR), tube feeding, and do-not-resuscitate (DNR) orders as well as other treatments. A living will is signed and witnessed, and copies are given to your personal physician as well as to family members and others whom you trust.

A living will should be as detailed as possible but may not cover all circumstances in a medical emergency. If you suffer a heart attack and someone calls 911, paramedics are required by law to administer CPR irrespective of what is stated in a living will. Only after you reach a hospital can the provisions in a living will be respected by physicians and hospital staff.

Another important document is a **healthcare power of attorney** in which you designate a spouse, family member, or close friend as the person responsible for health decisions in the event you are unable to make such decisions. The person you designate must be 18 years or older and cannot be one of your healthcare providers. Together, a living will and healthcare power of attorney make up your advance directive.

States differ considerably in the forms and terminology of advance directives. Help in understanding and completing advance directive forms can be obtained at several websites. Forms and instructions for each state can be obtained at www.compassionandchoices.org.

Everyone should execute advance directives to avoid a tragedy like Terri Schiavo's. Filing advance directives with your physician and family does not mean that you give up the right to make your own health decisions. Advance directives are used only if you become incapacitated and are unable to communicate.

Medical Aid in Dying

Medical aid in dying is an end-of-life medical practice in which a mentally capable, terminally ill adult with fewer than 6 months to live may request medication from her or his doctor for self-administration to bring about a peaceful death if her or his suffering becomes unbearable.



Self-Care: Image Visualization

Image Visualization

Your mind has the power to promote your personal wellness and to help healing. By dwelling on negative thoughts and images such as “I feel lousy,” you increase the chance that you will feel that way. On the other hand, by thinking positive thoughts such as “I feel great” or “Today is a good day,” you can create positive feelings and positive behavioral outcomes. You can put healing suggestions into your mind, too. For example, you can suggest to yourself that a headache will go away in an hour or a cold will be mild.

Directions

Find a quiet, pleasant place where you can sit or lie down comfortably. Remove any uncomfortable clothing, eyeglasses, or contact lenses. Turn off the phone, TV, and computer. Give yourself permission to relax and decide what you are going to visualize. It's probably best to begin with something specific. You can visualize yourself being slimmer, giving up cigarettes, being successful in an upcoming job interview, or taking an exam while feeling confident and sure of the answers. You can visualize yourself becoming physically stronger or an area of your body becoming well.

Allow your eyes to close and relax the muscles in the eyelids all the way—to the point where they are so relaxed and comfortable that you feel you are unable to pull your eyelids open. Then let your mind transfer that same comfortable, relaxed feeling to all the other parts of the body, one by one, from top to bottom—head, chest, arms, hands, back, stomach, legs, feet.

Imagine that you are floating on a white cloud bathed in warm sunlight. Everything is quiet and peaceful. You are warm and comfortable and serene. Allow your mind to visualize whatever scene or image it chooses that is related to what you want to improve or heal. Accept your mind's images. They are helping you to change, to feel better. Allow yourself to remain in this relaxed state while your mind continues to create pleasant, positive, beneficial images. Begin to notice how relaxed your body is and how good it feels.

Whenever your mind decides it wants to return to a fully awake state, you will automatically open your eyes and be fully aware of your surroundings. Notice how refreshed and relaxed you feel!

In 1997, Oregon passed the Death with Dignity Act, which legalized medical aid in dying in that state. In the first year after the bill passed, 23 persons received prescriptions for lethal medications, and 15 actually took the medicine and died. In 1999, physicians prescribed lethal medications to another 33 patients, but some died before they could take the drugs. In Oregon in 2016, 204 medical-aid-in-dying prescriptions were written by about 200 different physicians; 133 people actually took the medication and died. Over the 20 years that Oregon's Death with Dignity Act has been in effect, fewer than 1,000 individuals have requested a lethal prescription, and even among those many elected to die from their disease. So far, it is clear from these numbers that there has been no rush among terminally ill patients in Oregon to end their lives.

In the practice of medical aid in dying, a terminally ill patient who is mentally competent must express a desire to die on several occasions. Then a second physician must be consulted. If both physicians agree that the patient is mentally competent (not clinically depressed) and has an incurable, painful disease, one physician supplies the patient with the drugs for ending life.

Despite growing public support for medical aid in dying in the United States, there is still great resistance to its use, including among physicians, and clergy. California, Colorado, the District of Columbia, Hawaii, Montana, Maine, New Jersey, New Mexico, Oregon, Vermont, and Washington now permit medical aid in dying. Most other states criminalize any form of assisted suicide.

There is general agreement that end-of-life care needs to be improved. Studies show that of the more than 2 million people who die each year in the United States, almost half of hospitalized patients suffer serious pain in the days preceding death. And only about one-third of patients in nursing homes receive adequate pain relief. Two national healthcare organizations have proposed that every physician attending to a dying patient should make the following six promises:

1. You will have the best of medical treatment, aiming to prevent exacerbation, improve function and survival, and ensure comfort.

2. Your care will be continuous, comprehensive, and coordinated.
3. You and your family will be prepared for everything that is likely to happen in the course of your illness.
4. Your wishes will be sought and respected, and they will be followed whenever possible.
5. We will help you consider your personal and financial resources and we will respect your choices about their use.
6. We will do all we can to see that you and your family will have the opportunity to make the best of every day.

The public discussion over end-of-life treatments and legal options and problems has been active in the United States for more than a quarter of a century. In 1990, the U.S. Supreme Court ruled that it is legal to withhold or withdraw life support from dying patients who can no longer be helped medically.

Palliative Care

Palliative care is a branch of medicine that focuses on noncurative treatments for the dying. The World Health Organization defines palliative care as something that:

- Affirms life and regards dying as a normal process
- Neither hastens nor postpones death
- Provides relief from pain and other distressing symptoms
- Integrates the psychological and spiritual aspects of patient care
- Offers a support system to help patients live as actively as possible until death
- Offers a support system to help families cope with the patient's illness and death

When a person elects palliative care, the emphasis of treatment shifts from prolonging life to enhancing the quality of life that

remains, preserving a person's dignity, and relieving suffering. Usually, a team of health professionals, in consultation with the patient and family, will decide if palliative care is appropriate.

Many opponents of medical aid in dying embrace the concept of palliative care and believe that it is more in accord with the ethics of medical practice. Now that palliative care is seen as a reimbursable form of therapy by many health insurance programs, eventually all terminally ill patients may have access to such care and no longer have to fear prolonged pain and suffering.



Strong family ties are healthy for young and old alike.

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Hospice

The term **hospice** originally applied to medieval Christian hospitals caring for the poor, the aged, and the sick. Hospices also provided refuge for people on religious pilgrimages. Providing physical

necessities, medical care, and spiritual comfort was the primary purpose of the early religious hospices. In the United States, more than 6,000 hospices offer comprehensive care for terminally ill patients. The goal of a hospice is to meet the total health needs—physical, psychological, and spiritual—of patients who have weeks or months to live. Medications are given to ease pain, but heroic treatments are not attempted. Family and friends are free to visit with the patient in a comfortable setting, whether it is in a patient's home or a hospice facility.

The hospice philosophy is that dying is part of living and should not be resisted with a multitude of medical interventions. Hospice care is designed to control pain and make patients comfortable, but staff also are trained to discuss emotional and spiritual issues relevant to death. Counseling and social services are available in hospices, and close family members are encouraged to participate in daily activities.

In 1982, Congress passed the Medicare Hospice Benefit Act. This law ensures that Medicare will pay hospice costs for any terminally ill patient whose projected life expectancy is 6 months or fewer. Most hospices are enrolled in Medicare. Overall, about one in three Americans now dies under hospice care either at home or in a hospice facility.

Healthy Aging Depends on a Healthy Lifestyle

With the dramatic upward shift in average life expectancy in the United States and other countries, finding ways to improve health in elderly people has become a major challenge. Generally, increasing age is associated with increasing disability and functional impairments such as loss of mobility, sight, or hearing. One goal of gerontology is to find ways to minimize or postpone the disabilities that accompany aging so that quality of life extends to or gets close to the end of life.

The scientific evidence is now quite overwhelming that most of the disability and long-term medical care in elderly persons results from major chronic diseases that were already present in midlife. The most significant predictors of a healthy old age are low blood pressure and low serum glucose levels, not being obese, and not smoking cigarettes while young. These factors are also important in predicting such diseases as cardiovascular disease, cancer, and diabetes. Thus, the evidence points to the importance of developing healthy habits while young if the “golden years” are going to be enjoyed with one’s physical and mental abilities intact.



After Childhood and Adulthood There's Oldhood

We're all familiar with the periods of childhood and adulthood, but you don't hear much about *oldhood*. Childhood is the time of considerable physical, emotional, and social development, for which there are expectations, guidelines, rules, teachers, mentors, and laws. Most cultures have a marker for when childhood ends and adulthood begins, such as turning 18 or getting married. Unlike childhood, adulthood is given over to meeting the demands of work or career, marriage, parenthood, and other responsibilities and their attendant stresses and strains. Oldhood, which also has markers, such as turning 65 or retiring from an occupation, is often seen as a time of diminishing capacity and

opportunity. However, as with any other time in the life span, if one has one's health and financial and social support, oldhood can present an enormous diversity of opportunities for new experiences, work, creativity, and joy. There are fewer responsibilities and stress, and more time for exercise, sleep, and indulging one's intellect, and even engaging in a long-put-off passion. Oldhood may be the final epoch of life, but it does not have to be the least rewarding.

Persons surviving to age 55 today can expect to live another 25 years on average; those surviving to age 75 can expect to live another 10 to 12 years. Many of these older people are relatively healthy, and the length of time that they will be disabled before death is short. In general, people who live to the oldest ages without disabilities are those who have practiced good nutrition, were physically and mentally active, and did not use tobacco or drink alcohol excessively.

More and more attention is being paid to the role of nutrition in healthy aging. Increased consumption of fresh fruits and vegetables is thought to slow the aging processes; those containing antioxidant chemicals are regarded as particularly potent antiaging foods. These include avocado, berries, broccoli, cabbage, carrots, citrus, grapes, onions, tomatoes, and spinach. Coffee and tea also contain significant amounts of antioxidants. According to believers in the antioxidant theory of aging, however, supplements still are needed to ensure that you are getting sufficient amounts of antioxidant vitamins and minerals.

Every age of life provides opportunities for growth and satisfaction. Even though we have no way of knowing when serious illness or death will confront us, we do have control of how we live each day and the satisfactions we find in life. The way we choose to live when we are young will greatly affect our health later. For example, smoking while young increases the likelihood of developing cancer and heart disease later. Drinking alcohol to excess and taking unnecessary chances invite accidents that can cause death or permanent disability. Although each person's life span is partly determined by genes, environmental factors such as nutrition,

exercise, and lifestyle are also important in determining not only how long we live but also how well we live.

Critical Thinking About Health

1. Imagine that you have just learned that your mother is suffering from terminal cancer that cannot be treated. The physician estimates that death can occur at any time within a few months and that your mother's pain will be considerable. Although drugs can alleviate some of the pain, the doctor honestly does not know how effective the pain relief will be. Your mother is 75 years old and is aware of her condition. When you and she discuss her condition, she expresses a strong desire not to suffer to survive a few weeks or months more. She asks you to help her obtain drugs that she can use to end her life peacefully whenever she chooses.

Describe how you would feel in such a situation and what actions you would take. Would you discuss the problem with her physician, with a religious counselor, or with someone else? Would you be concerned about legal problems if you did obtain the lethal drugs and give them to your mother? Would you tell your mother that you want to keep her alive at all costs and you will do all that you can to reduce her suffering? Make a list of all the steps you would take in this situation and explain your reasons for each action.

2. Make a list of all the health-related factors in your life that you think might play a role in how healthy you will be at age 70 (e.g., you smoke cigarettes, you are significantly overweight). After thinking about the list you have made, ask yourself if some behaviors or lifestyle factors are worth changing to help ensure that you will enjoy a healthy old age. Or perhaps you feel that it is not worth worrying about old age and that the important thing is to enjoy life now. Discuss these different views and try to develop a personal philosophy of aging that is right for you.
3. Consider the situation of a college student whose grandmothers both have Alzheimer's disease, and the other members of the family are extremely concerned over their own future mental

health. Having read that a particular gene contributes to the risk of Alzheimer's disease and that doctors can test for the presence of this gene, your student's mother and father have been discussing getting the Alzheimer's test. What advice would you give them? Would you want to be tested for the Alzheimer's susceptibility gene? Discuss in detail the reasons for your advice to them and the decision you would make for yourself.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

When we are young, we rarely think about growing old or dying. When we are old, we often think about what we could have done when we were young to make us healthier now that we are old. But every stage of life has its different perceptions, needs, worries, and goals. At 17, your primary goal was probably getting the attention from someone you admire; at 77, your goal may be getting through the day without pain. Many young people today will live into their 80s, 90s, or older. How well, active, and mentally alert you will be depends in large measure on how much attention you pay to your health and lifestyle while young. Living a long, healthy life depends on the genes you inherited and the lifestyle you lead. For the same reasons you put money into a retirement account to ensure financial security in your later years, you should think about banking some healthy habits when you are young. Maintaining a healthy weight and diet, not smoking, and getting regular exercise are among ways to invest in a healthy old age. It's even worth visualizing playing several sets of tennis, playing 18 holes of golf, or possibly running a marathon when you are 80 years old. As the great Yankee catcher Yogi Berra once quipped, "It is very hard to make predictions . . . especially about the future."

Dying is like that. We never know how many days and years we are allotted. So, rather than fear death, we should engage in and enjoy life day by day. Life can be envisioned as a voyage. Some days are slow, calm, and without incident; others are turbulent, frenzied, and stormy; still others are beautiful and rewarding. Accept each day and what it offers. One thing is certain; all things change with time, including your loves, despairs, failures, and successes. It is difficult to make light of death, but Woody Allen came close when he remarked, "I don't mind dying; I just don't want to be there when it happens."

HIGHLIGHTS

- Aging and dying are natural stages of life. People should strive to remain physically, emotionally, mentally, and spiritually active at all stages of life regardless of chronological age.
- The maximum human life span is approximately 115 years; the average life span in many countries is 80+ years, which means that half of the people in those countries will live to be 80 years of age or older.
- The average age of the population in the United States is rising rapidly, increasing healthcare costs and causing problems for the Social Security system.
- Aging is partly determined by genes and partly by environmental factors that cause cellular damage. Caloric restriction slows aging in laboratory animals but is impractical in people.
- Loss of cognitive abilities in the elderly is called *senile dementia*; the major cause of mental deterioration is Alzheimer's disease.
- Parkinson's disease is a neurodegenerative disease that affects movement.
- Bone loss in the elderly causes osteoporosis.
- The major cause of vision loss in the elderly is macular degeneration.
- Advance directives consist of executing a living will and a healthcare power of attorney.
- Palliative care is treatment that does not cure but that relieves pain and suffering of dying patients and deals with the distress of family members.

- Hospice care provides terminally ill patients with medical, emotional, and spiritual support during the final weeks or months of their lives.
- Successful aging depends on maintaining a healthy weight; eating a nutritious, balanced diet; getting lots of exercise; and keeping mentally active.

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KEY TERMS

aging:

normal changes in body functions that begin after sexual maturity and continue until death

average life expectancy:

average number of years a person can expect to live

maximum human life span:

the theoretical maximum number of years that individuals of a species can live

telomeres:

DNA at the ends of chromosomes that protect the integrity of genetic information during cellular replication

free radicals:

highly reactive molecules that can damage cellular structures

senile dementia:

loss of cognitive functions in elderly people

Alzheimer's disease (AD):

a common cause of senile dementia and other symptoms, eventually leading to death

tau tangles:

aggregates of a brain protein called tau; a diagnostic indicator for Alzheimer's disease

amyloid protein:

an abnormal protein in the brain of patients with Alzheimer's disease

Parkinson's disease (PD):

chronic and progressive neurodegenerative disease; second most common neurodegenerative disease among older persons

osteoporosis:

a condition in older people, particularly women, in which bones lose density and become porous and brittle

hormone replacement therapy (HRT):

administration of estrogen to menopausal and postmenopausal women to help prevent symptoms of menopause, osteoporosis, and heart disease

age-related macular degeneration (AMD):

loss of vision as a result of death of cells in a region of the eye called the *macula*; loss of vision progresses slowly over several years

age-related hearing loss:

loss of hearing with advancing age; some loss of hearing may be caused by exposure to loud noise earlier in life

advance directive:

legal documents that express someone's desires regarding treatments should then be unable to communicate. A living will and a healthcare power of attorney constitute an advance directive

living will:

a legal document that expresses your wishes regarding treatment if you become unable to make your own medical decisions

healthcare power of attorney:

designates someone to make healthcare decisions for you if you are unable to communicate

medical aid in dying:

a physician assistance to help a patient who no longer desires to live because of pain or an incurable illness to die

hospice:

a place for terminally ill patients to spend the time before death in an environment that attends to their physical, emotional, and spiritual needs but does not administer any further treatments; hospice care also can be given in a patient's home



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CHAPTER 17

Unintentional and Intentional Injuries



Health Tips

Ways to Avoid Having a Motor Vehicle Accident

Driving Defensively

Avoid Falls at Christmas

Protecting Kids from Firearm Death

Hotline for Domestic Violence Help

How to Prevent Date Rape

Preventing Sexual Assault



Wellness Guide

Smoke Alarms Protect You from Fires

Prevent Computer-Related Injuries

Be Your Own Best Friend

LEARNING OBJECTIVES

1. Define *unintentional and intentional injuries*.
2. Describe various strategies to prevent unintentional and intentional injuries.
3. Describe the Haddon Matrix and explain why it was developed.
4. Discuss various ways to prevent motor vehicle crashes and pedestrian accidents.
5. Describe various strategies to improve home and work safety.
6. Discuss ways to prevent firearm injuries.
7. Describe the different kinds of intimate partner violence.
8. Describe the different forms of child maltreatment.
9. Define *elder abuse* and the factors that contribute to it.
10. Define *sexual assault, forcible rape, and acquaintance rape* and how they affect college students

People encounter all manner of injurious situations. Some injuries are unintentional (we call them *accidents*) and some are intentional (self-harm or interpersonal assault). In 2019, among Americans of all ages, unintentional injuries from falls, car crashes, and poisonings (usually drug overdose) were the third leading cause of death, after heart disease and cancer. Intentional injuries from suicide and

homicide claimed about 60,000 American lives. Injuries are the leading cause of disability among young people and cause more deaths in children than all infectious diseases combined.

Unintentional Injuries

Unintentional injury refers to the results and health consequences of an **accident**, which is defined by the National Safety Council as “that occurrence in a sequence of events which produces unintended injury, death, or property damage. Accident refers to the event, not the result of the event.”

The best way to avoid something is to cause that which is to be avoided, to avoid you of its own accord.

—Sufi proverb

Many people believe accidents are occurrences over which people have no control. Whereas some accidents are the result of bad luck and chance, many accidents and the injuries resulting from them are caused by social and economic conditions—unsafe roads and automobiles, unsafe homes and worksites—and personal factors such as poor judgment, lapses in attention, recklessness, loss of emotional control, and mental states that are imbalanced by alcohol and drugs. Insofar as the environment can be made safer and individuals become more cautious, the number of unintentional injuries from accidents can be reduced.

Deaths from unintentional injuries result from motor vehicle accidents, home accidents (falls, fires, poisonings), workplace accidents, firearm accidents, and other causes (**Table 17.1**). The greatest number of deaths occur as a result of motor vehicle crashes, falls, and poisonings, including drug overdoses and toxicity. Teenagers and young adults are most likely to die in motor vehicle crashes, middle-aged persons by poisoning and drug overdose or toxicity, and the elderly by falls (**Figure 17.1**).

TABLE 17.1 | **Leading Causes of Unintentional Injury Deaths in the United States in 2021**

Cause of death is ascribed to a single category even though many factors contribute to an accident.

Cause of Death	Number of Deaths
Poisonings (drug overdose)	72,473

Cause of death is ascribed to a single category even though many factors contribute to an accident.

Cause of Death	Number of Deaths
Motor vehicle accidents	37,991
Falls	38,707
Drownings	3,406
Exposure to smoke and flames	3,704
All others	16,759
Total unintentional injury deaths	173,040

Data from U.S. National Center for Health Statistics. (2021). Deaths: Final Data for 2018. *National Vital Statistics Reports, Volume 69*, Number 13. 69-13-508.pdf <http://www.cdc.gov/nchs/data/nvsr/nvsr>

10 Leading Causes of Death by Age Group, United States – 2018

Rank	Age Groups										Total
	<1	1–4	5–9	10–14	15–24	25–34	35–44	45–54	55–64	65+	
1	Congenital Anomalies 4,473	Unintentional Injury 1,226	Unintentional Injury 734	Unintentional Injury 692	Unintentional Injury 12,044	Unintentional Injury 24,614	Unintentional Injury 22,667	Malignant Neoplasms 37,301	Malignant Neoplasms 113,947	Heart Disease 526,509	Heart Disease 655,381
2	Short Gestation 3,679	Congenital Anomalies 384	Malignant Neoplasms 393	Suicide 596	Suicide 6,211	Suicide 8,020	Malignant Neoplasms 10,640	Heart Disease 32,220	Heart Disease 81,042	Malignant Neoplasms 431,102	Malignant Neoplasms 599,274
3	Maternal Pregnancy Comp. 1,358	Homicide 353	Congenital Anomalies 201	Malignant Neoplasms 450	Homicide 4,607	Homicide 5,234	Heart Disease 10,532	Unintentional Injury 23,056	Unintentional Injury 23,639	Chronic Low. Respiratory Disease 135,560	Unintentional Injury 167,127
4	SIDS 1,334	Malignant Neoplasms 326	Homicide 121	Congenital Anomalies 172	Malignant Neoplasms 1,371	Malignant Neoplasms 3,684	Suicide 7,521	Suicide 8,345	Chronic Low. Respiratory Disease 18,804	Cerebro-vascular 127,244	Chronic Low. Respiratory Disease 159,486
5	Unintentional Injury 1,168	Influenza & Pneumonia 122	Influenza & Pneumonia 71	Homicide 168	Heart Disease 905	Heart Disease 3,561	Homicide 3,304	Liver Disease 8,157	Diabetes Mellitus 14,941	Alzheimer's Disease 120,658	Cerebro-vascular 147,810
6	Placenta Cord. Membranes 724	Heart Disease 115	Chronic Low. Respiratory Disease 68	Heart Disease 101	Congenital Anomalies 354	Liver Disease 1,008	Liver Disease 3,108	Diabetes Mellitus 6,414	Liver Disease 13,945	Diabetes Mellitus 60,182	Alzheimer's Disease 122,019
7	Bacterial Sepsis 579	Perinatal Period 62	Heart Disease 68	Chronic Low Respiratory Disease 64	Diabetes Mellitus 246	Diabetes Mellitus 837	Diabetes Mellitus 2,282	Cerebro-vascular 5,128	Cerebro-vascular 12,789	Unintentional Injury 48,295	Diabetes Mellitus 84,946
8	Circulatory System Disease 428	Septicemia 54	Cerebro-vascular 34	Cerebro-vascular 43	Influenza & Pneumonia 200	Cerebro-vascular 567	Cerebro-vascular 1,704	Chronic Low. Respiratory Disease 3,807	Suicide 8540	Influenza & Pneumonia 48,888	Influenza & Pneumonia 59,120
9	Respiratory Distress 390	Chronic Low. Respiratory Disease 50	Septicemia 34	Influenza & Pneumonia 51	Chronic Low. Respiratory Disease 165	HIV 482	Influenza & Pneumonia 956	Influenza & Pneumonia 2,380	Septicemia 5,956	Nephritis 42,232	Nephritis 51,386
10	Neonatal Hemorrhage 375	Cerebro-vascular 43	Benign Neoplasms 19	Benign Neoplasms 30	Complicated pregnancy 151	Influenza & Pneumonia 457	Septicemia 829	Influenza & Pneumonia 2,339	Influenza & Pneumonia 5,858	Parkinson's Disease 32,988	Suicide 48,344

Figure 17.1 Ten Leading Causes of Unintentional Injury Deaths by Age Group, United States, 2018.

Unintentional injuries are denoted by colored boxes.

U.S. Centers for Disease Control and Prevention. (2020).

Description Description

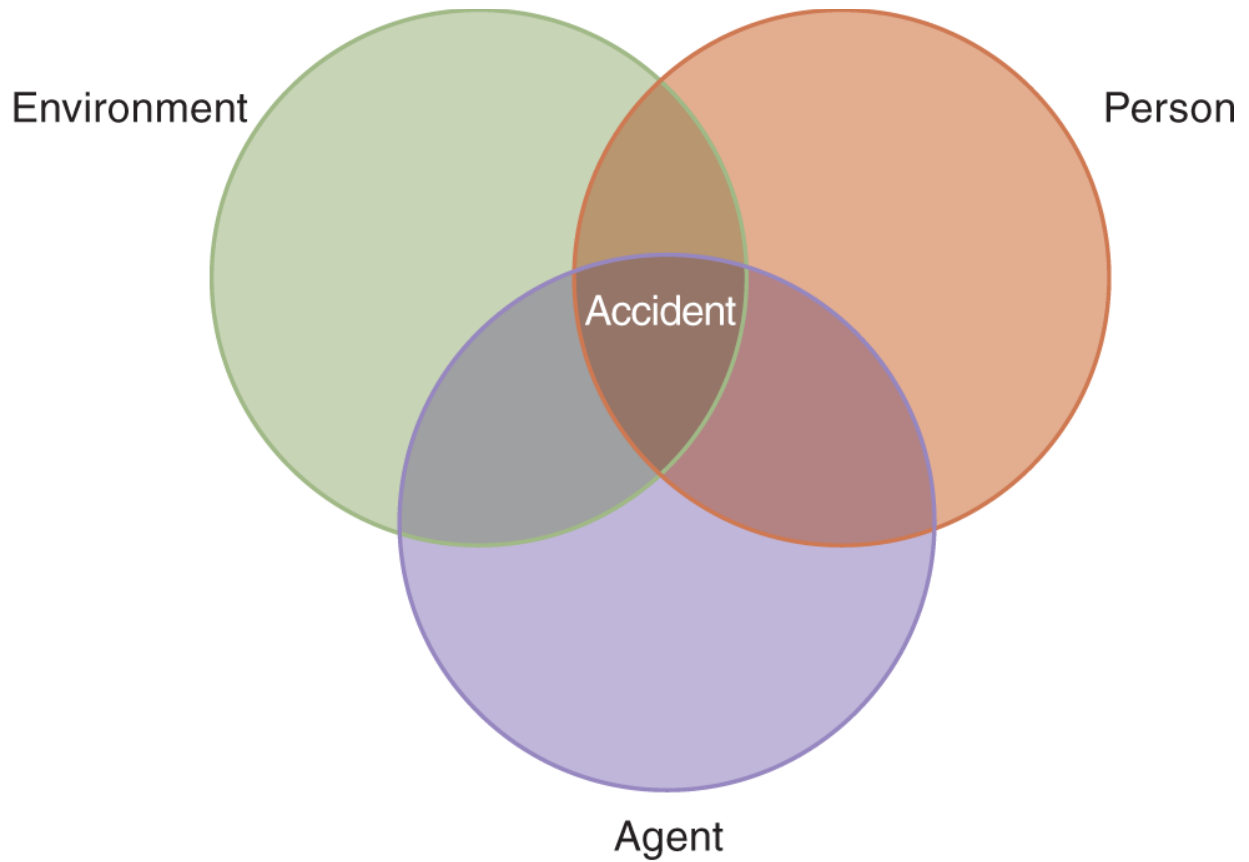
Reducing the Risk of Accidents

When considering the consequences and prevention of accidents, public health professionals focus on **accident mitigation**—methods to reduce damage caused by unplanned events—and **accident prevention**—ways to eliminate the occurrence of unintended injuries. Accident mitigation and prevention can be viewed in two contexts: (1) individual or personal and (2) environmental or community. Many factors are involved in unintentional injury:

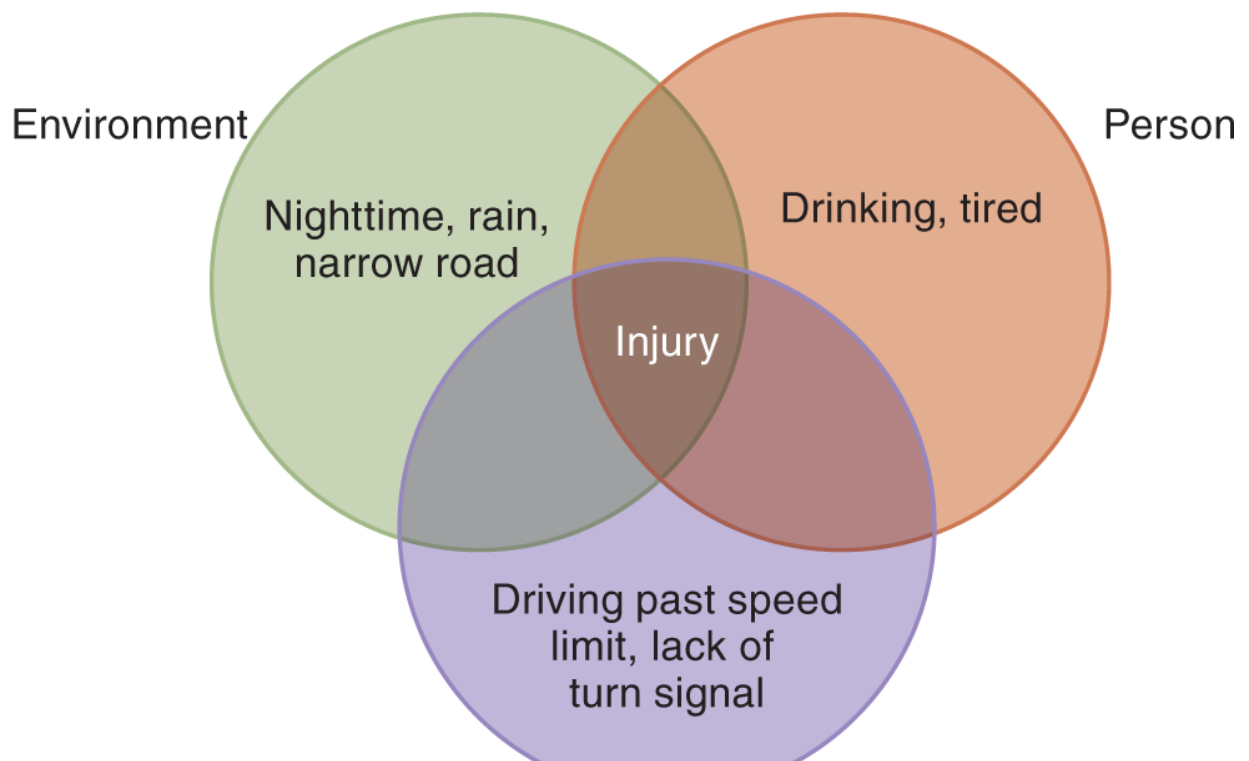
- Attitudes and beliefs can lead some to think safety precautions are unnecessary because one cannot control situations or that taking risks is fun or exciting.
- When someone lacks knowledge and skills when performing a new procedure or task (e.g., operating a new power tool before reading the instructions, operating a motorcycle the first time, or using a new kitchen appliance). A child or an elderly person may not be able to or may be too young to perform a task competently.
- When someone lacks the funds to replace unsafe or old equipment or obtain proper training in safety-related matters.
- When someone uses alcohol or drugs or takes prescribed medications, especially those with a sedative effect.
- When environmental factors such as appropriate maintenance of streets, power transmission, and sewage treatment are not maintained safely, and laws that regulate the hazards of appliances and tools are not followed.
- Stress and fatigue can interfere with concentration when performing even a simple task or distract while engaged in an activity. Fatigue causes slower reaction times, impairs coordination, and induces sleepiness.

Analysis of Unintentional Injury

Injury epidemiology is used to investigate risk factors that cause unintentional injuries. For injuries to result, three factors are involved: (1) the agent or source of energy exchange (i.e., mechanical, chemical, electrical, or thermal), (2) the vehicle for the transmission of mechanical energy (e.g., a car, truck, motorcycle, power line, or poison), and (3) a host or object (e.g., a person, school building, or house) (**Figure 17.2**).



A





B

Figure 17.2 Epidemiologic Model for Unintentional Injuries. The model shows that (a) the environment, a person, and an agent (car) interact to create conditions for an accident. Part (b) shows the factors that increases the likelihood of an injury.

Description

The Haddon Matrix is used in unintentional injury analysis. Developed by William Haddon Jr. in the 1960s, this model was used originally to investigate motor vehicle risk factors and to develop and implement programs to prevent or reduce the occurrence of car accidents.

According to some estimates, “every two miles, the average driver makes 400 observations, 40 decisions, and one mistake. Once in every 500 miles, one of these mistakes leads to a near collision, and once in every 61,000 miles, one of these mistakes leads to a car crash” (Gladwell, 2001). The Haddon Matrix analyzes accidents in three phases:

Phase 1: Pre-event phase. Includes factors that may determine whether an accident will happen; lack of knowledge or skills and alcohol use are the most significant factors.

Phase 2: Event phase. Occurs when the host comes into contact with forces of energy. Many preventive measures such as the use of helmets, seat belts, or protective goggles are associated with this phase.

Phase 3: Postevent phase. Includes emergency procedures provided after the injury has occurred. Preventive signaling devices, smoke and carbon monoxide detectors, or fire alarms will increase the speed with which help reaches an injured person. Emergency transportation and care of an injured or sick person occur in this phase.

All approaches to unintentional injury reduction include (1) educational and prevention strategies, (2) stricter laws and regulations (e.g., mandates to enforce seat belt and helmet compliance), and (3) better product design and automatic protection devices (e.g., air bags, child-proof car door locks, child-proof safety caps on medicines).

Motor Vehicle Safety

Motor vehicle travel is a primary means of transportation in North America and much of the world. For all its advantages, however, injuries resulting from motor vehicle crashes are a leading cause of death. Each year, approximately 38,000 Americans are killed in motor vehicle crashes, and about 3 million to 4 million suffer serious injuries. The annual cost to American society from vehicle and property damage, medical costs, and lost productivity from motor vehicle crashes is about \$460 billion. The main causes of more than 2 million U.S. motor vehicle crashes are alcohol impairment, distracted driving, speeding, improper driving, and an unsafe vehicle.

Alcohol-Impaired Driving

The National Highway Traffic Safety Administration (NHTSA, 2020) estimates that alcohol is involved in about 30% of fatal crashes and 7% of all traffic accidents, fatal and nonfatal. Alcohol involvement in fatal crashes during the day is 27% but rises to 69% at night. More than 1 million drivers are arrested for driving under the influence of alcohol or other drugs every year. In about one-third of pedestrian fatalities involving a motor vehicle, the pedestrian was intoxicated.

Distracted Driving

About 90% of car crashes involve human error; driving safely requires concentration and alertness in the best of circumstances. Driving when distracted by eating, removing a jacket or sweater, texting, being involved with a screen in any way (including navigation), or having a conversation with a passenger or on the phone (especially an emotional one) multiplies the risk for a serious crash. This is the reason nearly all U.S. states limit in some way cell phone use while driving.

Speeding

Speeding—exceeding the posted speed limit or driving too fast in bad weather or on unsafe roads—is involved in about 25% of motor vehicle fatalities. At 55 miles per hour, a vehicle travels the length of a football field in 3.7 seconds. Speeding reduces the amount of time to react to avoid a crash, increases vehicle stopping distance, and limits the time for the driver to take advantage of road safety measures such as guardrails, crash cushions, and median dividers.



Ways to Avoid Having a Motor Vehicle Accident

Resolve to do the following each time you drive:

- Don't drive when you are sleep deprived or otherwise tired.
- Wear your seat belt.
- Don't drive after consuming alcohol, marijuana, or other drugs.
- Don't interact with a cell phone or any screen device while driving.
- Don't speed or drive aggressively.

Remember: A motor vehicle accident injury occurs once every 13 seconds; a death occurs once every 12 minutes.

Improper Driving

Improper driving involves *inattention* (falling sleep, emotional distraction, daydreaming, involvement with something inside or outside the car that doesn't involve safe driving), *judgment errors* (driving too fast on a curve or for weather or road conditions, dangerous maneuvers, unsafe estimation of whereabouts or nearby vehicles, road rage), or *loss of control* (or overcompensating for a driving error).

Unsafe Vehicle

A vehicle regarded as unsafe has one or more of the following: mechanical defects, bad tires, faulty brakes, inoperative turn signals and headlights, or faulty steering.

Two-Wheel Vehicle Safety

Two-wheel vehicles such as motorcycles, motor scooters, and mopeds can be appealing: low cost to purchase, repair, and operate; the feeling of open-air riding; and the association with fellow two-wheel vehicle riders. However, two-wheel vehicles are less visible to four-wheel (and more) vehicle drivers and provide less crash protection to riders and passengers. Two-wheel vehicle operators can ensure a safer ride by securing proper training in operational procedures and by using a helmet and proper protective clothing. Wearing a helmet reduces the likelihood of fatal injuries in an accident by about 37%. Protective clothing such as long sleeves and pants, jackets, and boots may lessen the chance for abrasions should an accident occur as well as protect from bad weather.



A helmet and protective clothing are essential to motorcycle safety.

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Pedestrian Safety

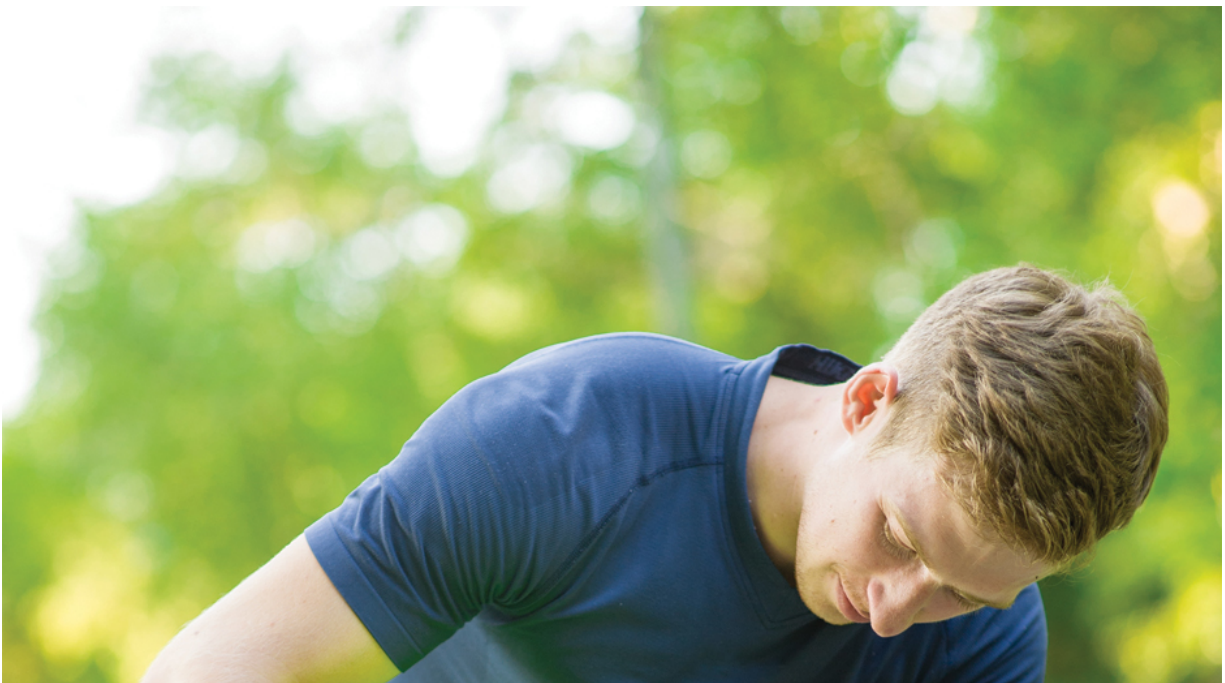
Each year in the United States, about 70,000 pedestrians are injured in motor vehicle accidents and about 4,500 are killed. About 80% of all pedestrian deaths and injuries involve children ages 5 to 9 who are either crossing or entering a street. Among young children, implementation of preventive strategies and educational efforts addressing safety procedures in traffic areas may reduce accidents. Many young children don't know what traffic signals or signs mean. Young children are also unable to judge the distance and speed of vehicles, which puts them in danger when trying to cross an intersection. Close supervision by adults helps prevent accidents; safety education of child-care workers is another preventive strategy.



Driving Defensively

Driving defensively means not only taking responsibility for yourself and your actions but also keeping an eye on “the other guy.” The National Safety Council offers the following guidelines to help reduce your risks on the road:

- Don't leave the driveway without securing each passenger in the car, including children and pets. Seat belts save thousands of lives each year!
- Remember that driving too fast or too slow can increase the likelihood of collisions.
- If you plan to drink, designate a driver who won't drink.
- Be alert! If you notice that a car is straddling the center line, weaving, making wide turns, stopping abruptly, responding slowly to traffic signals, or speeding up and slowing down for no apparent reason, the driver may be impaired.
- Avoid an impaired driver by slowing down, letting the driver pass, pulling onto the shoulder, or turning right at the nearest corner. If it appears that an oncoming car is crossing into your lane, pull over to the roadside, sound the horn, and flash your lights.
- Notify the police immediately after seeing a motorist who is driving suspiciously.
- Follow the rules of the road. Don't contest the right of way or try to race another car during a merge. Be respectful of other motorists.
- While driving, be cautious, aware, and responsible.





Helmet and reflector use is crucial to bicycle safety. Bicycle riders are required to follow the same rules of the road as automobile operators. Bicycle riders should wear bright, reflective clothing, and the bicycle itself should be equipped with reflectors and lights.

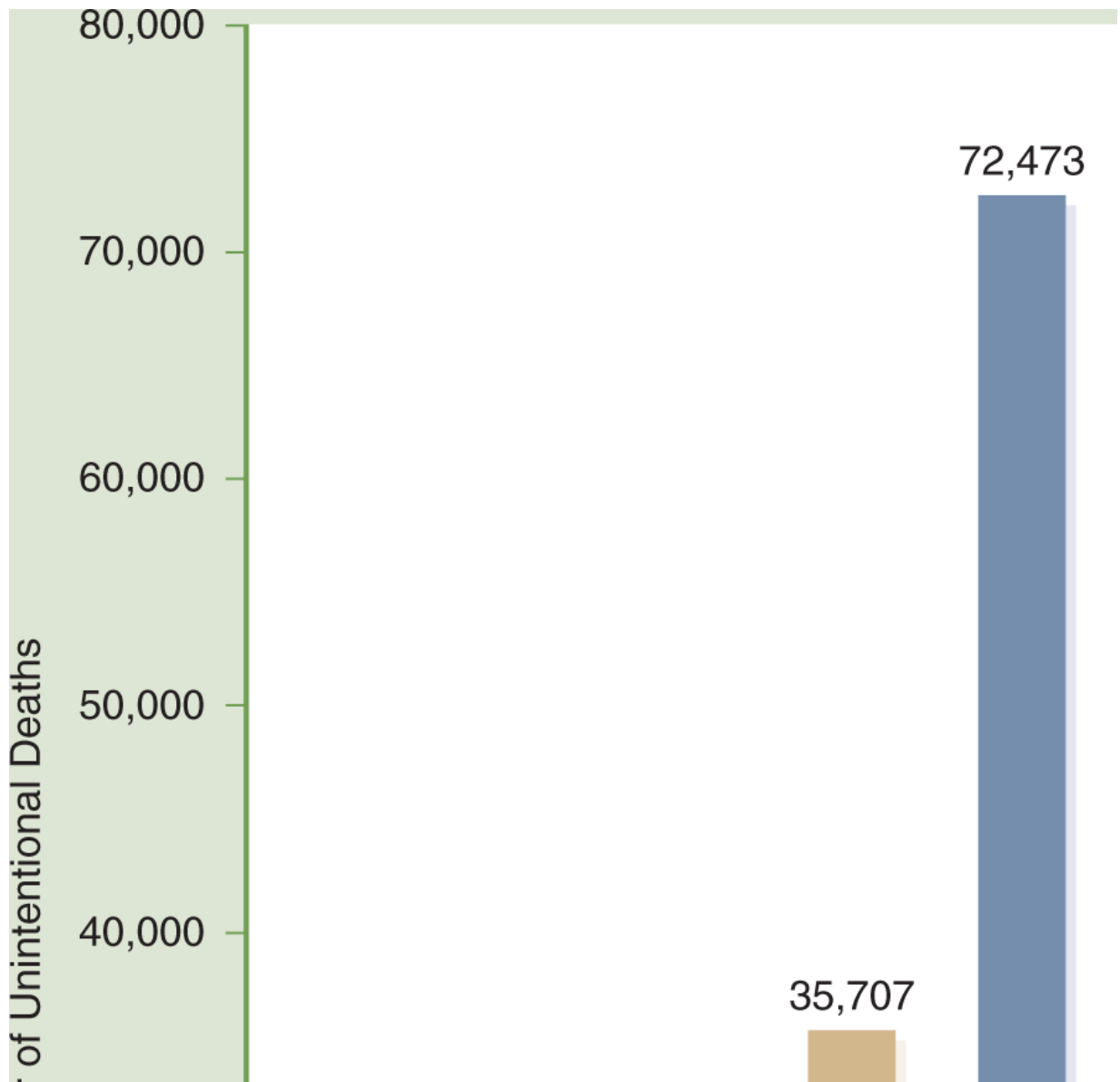
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Some pedestrian injuries occur when individuals dart into a busy street or are unable to see oncoming traffic because their view is blocked by a parked vehicle. The elderly are especially at risk for pedestrian injuries as a result of failing eyesight, hearing, and mobility problems. Many pedestrian injuries involve joggers, runners, and walkers. Bright-colored clothes, especially reflective clothes, offer protection for pedestrians during both day and night. Also, just

as alcohol impairs the judgment of motor vehicle operators, it impairs the judgment of pedestrians. Pedestrians should always walk to a corner that has a stop sign or signal light; crossing in the middle of a block is dangerous even if there is a marked crosswalk.

Home and Community Safety

Home accidents include falls, poisonings, fires, suffocation, and drowning ([Figure 17.3](#)). Disabling injuries in the home number more than 30 million—more than all automobile and workplace accidents combined. Approximately 90,300 persons die from falls, poisonings, fires, and other accidents in homes. The annual cost of home and community injuries and deaths is more than \$30 billion.



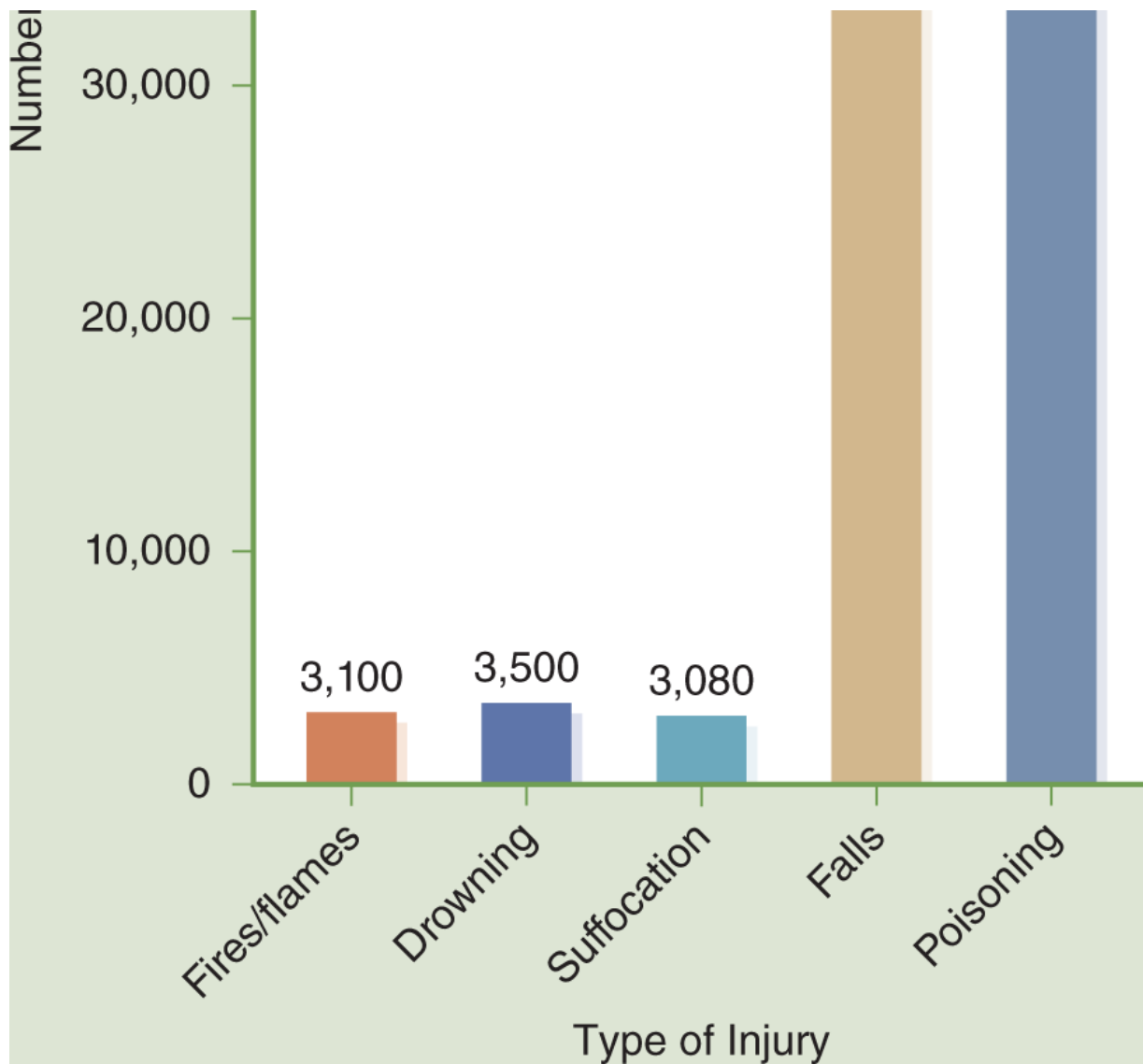


Figure 17.3 Approximate Number of Unintentional Injury Deaths at Home and in the Community, United States, 2018.

Data from U.S. National Center for Health Statistics. (2021). Deaths: Final Data for 2018.

National Vital Statistics Reports, Volume 69, Number 13. Retrieved from:

<http://www.cdc.gov/nchs/data/nvsr/nvsr69/nvsr69-13-508.pdf>

Description

Falls

Falls are the leading cause of deaths from unintentional injuries in the home and community. People of all ages fall, but most fatal falls occur among elderly persons. Children often fall while playing but

usually the injuries are minor. Serious injuries occur when children fall downstairs, out of trees, from open windows, and from the backs of trucks. People responsible for children must be constantly alert to the danger of a fall.



Avoid Falls at Christmas

Every year, several thousand Americans suffer injuries from falls while decorating a Christmas tree. Be extra cautious during the holiday season and remember these tips when decorating a tree:

- Make sure any ladder you use is stable. If leaned against a wall, observe the 4 to 1 rule: If you climb 4 feet, the base of the ladder should be 1 foot from the wall; for 8 feet, the base should be 2 feet from the wall.
- Do not lean backward or sideways from the ladder. Keep feet in the center of each step.
- Do not overload the top of the tree with ornaments or lights.
- Do not place candles on or near the tree. A Christmas tree is a match waiting to be lit.
- Make sure Christmas tree lights are in good condition and will not spark or cause a wire to become hot. Test lights before stringing them on trees.

Enjoy the holiday season and avoid accidents.

Falls are an especially serious problem for the elderly. Each year, 27% of Americans older than age 65 and 30% of Americans older than age 75 fall and suffer an injury (Bergen et al., 2016). Two-thirds of those who fall will experience another fall within 6 months of the first fall. About 40% of all nursing home admissions result from injuries suffered in falls. When an elderly person falls, it can result in hospitalization and permanent loss of independent living. It is no wonder that many older people have a fear of falling.

Elderly persons can lower the risk of falls by engaging in regular movement, strength, balance, and flexibility exercises that are appropriate for them. Using canes or other walking aids may help avert a fall. If an area is unfamiliar, an unsteady older person can ask someone for physical support.

Certain areas in the home are hazardous for falls: the kitchen, bathroom, and laundry room because of wet floors; stairs because of stumbling, particularly if not well lit or there is no handrail; bumping into furniture or tripping over the legs of tables, chairs, or loose rugs; standing on chairs and step stools or climbing ladders; and pets running free in the house.

Traumatic Brain Injury

A **traumatic brain injury (TBI)** is caused by a bump, blow, or jolt to the head (including shaking of babies) that results in impaired thinking or memory, altered movement or sensation (e.g., vision or hearing), personality changes, or emotional problems such as depression. Nearly 3 million TBIs occur in the United States every year. Falls are the most common causes of TBI, accounting for nearly half of all TBI-related hospital visits. TBIs from falls occur frequently among the elderly, who may trip over objects in their homes or be unstable because of medication side effects that affect balance. Young people also are frequently affected by falls while playing or riding a bike. Being struck by or against an object is the second leading cause of TBI. These injuries also can occur from collisions with other players in a game, being hit by a ball or bat, or bumping into a low beam in an old house. Motor vehicle crashes are the third leading cause of TBI-related injuries.

The severity of a TBI may range from *mild* (i.e., a brief change in mental status or consciousness) to *severe* (i.e., an extended period of unconsciousness or memory loss after the injury). About half of TBIs do not cause loss of consciousness or require medical intervention. A serious TBI may result in loss of consciousness and cognitive acuity, memory loss, or changes in behavior. A small number of TBIs result in permanent brain damage.

Poisonings

A **poison** is any chemical substance that causes illness, injury, or death. Poisons enter the body by being ingested (medicines, drugs,

mushrooms, shellfish, chemicals), inhaled (carbon monoxide, hydrogen sulfide), or injected (bee sting, snake bite) or by contact with the skin (poison ivy, solutions that burn). Some poisons cause only transitory symptoms; the body returns to normal once the poison is eliminated. However, some poisons cause permanent and irreversible damage.

Young children, especially when they have just learned to crawl or walk, are particularly susceptible to poisoning accidents. When children are hungry, thirsty, or just curious, they might ingest whatever they find, including pills, household products, and pesticides. Children between ages 1 and 5 years suffer the greatest number of accidental poisonings.

Precautions by manufacturers of drugs, solvents, paints, and other products have markedly reduced the number of accidental childhood poisonings. Precautions by parents and other child caregivers are essential to reduce the risk further. All household products and medicines should be kept out of reach of small children. Dangerous substances should be kept in locked cabinets. Small children should not be left unsupervised where dangerous household products are stored.

The United States has several hundred poison control centers. For a list of these centers across the country, check www.aapcc.org. For immediate help, call the poison emergency helpline at 800-222-1222 or check the poisonhelp.org website. Should a poisoning accident occur, someone at a poison control center can give you immediate expert advice.

Many cultivated and wild plants, trees, and bushes contain poisonous compounds. Eating the berries, seeds, roots, or leaves of unfamiliar plants can produce mild or severe symptoms of poisoning. Many common household plants are also poisonous, even the Christmas poinsettia. Collecting and eating wild mushrooms can be dangerous unless you are knowledgeable about what species are edible.

Illness or death from unintentional overdose of a prescription or nonprescription drug is considered poisoning. Such poisonings occur when a particular drug is taken accidentally, too much of a drug is

taken accidentally, the wrong drug is given or taken in error, or an accident occurs in the use of a drug(s) in medical and surgical procedures. For example, acetaminophen (known as Tylenol in the United States and paracetamol in other countries) is one of the most widely used drugs for pain, headache, colds, and other symptoms. It also is a common cause of poisoning worldwide mostly from acute liver toxicity. Many people ingest excessive amounts of acetaminophen because they misunderstand dosing directions or do not realize that acetaminophen is found in more than one medication they are using.

In recent years, deaths in the United States from drug overdose increased significantly (**Figure 17.4**), in great measure because of the misuse of opioid prescription pain relievers and “street” opioids such as heroin and fentanyl. In 2019, about 10 million people misused opioids. Also, as many as 100,000 babies were born addicted to opioids and suffering consequent withdrawal (*neonatal abstinence syndrome*) because their mothers misused opioids during pregnancy. The cost of prescription opioid misuse in the United States to cover the costs of health care, lost productivity, addiction treatment, and criminal justice involvement is nearly \$200 billion annually.

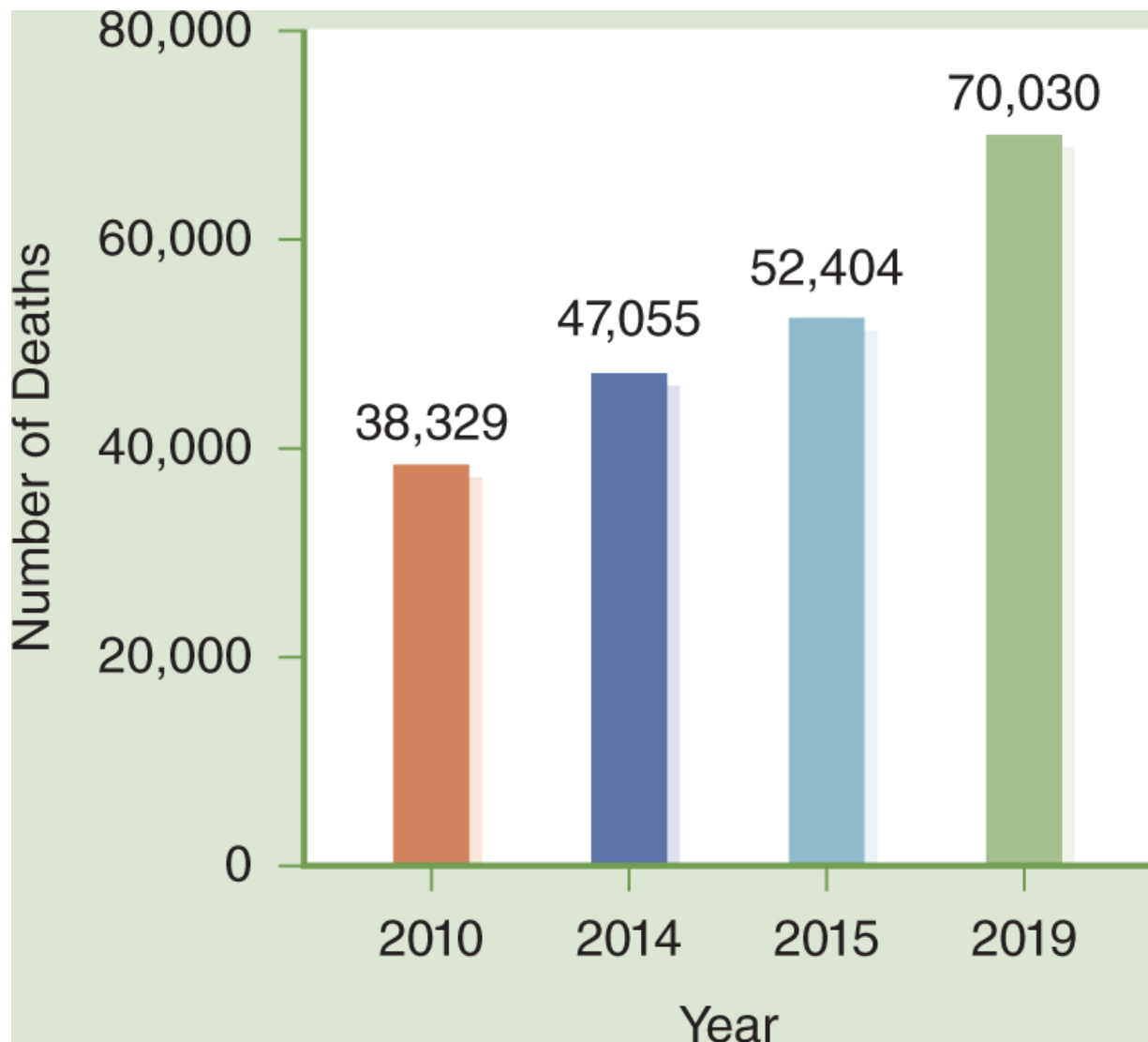


Figure 17.4 U.S. Deaths from Drug Overdose, 2010–2019. About 90% of drug overdose deaths are to the result of opioid misuse related to medically treated complaints of pain.

Data show that the increase in opioid overdose deaths occurs most frequently among middle-aged, non-Hispanic White people with a high school diploma or less. This group's significant risk for opioid misuse is thought to result from long-term steady deterioration in economic and social well-being, which lead to increases in persons experiencing physical pain and poor health and mental health (Case & Deaton, 2017).

Data from National Institute on Drug Abuse (2021). Overdose death rates. <https://www.drugabuse.gov/drug-topics/trends-statistics/overdose-death-rates/>

Description

Poisoning by gases and vapors is mainly caused by carbon monoxide. Carbon monoxide results from incomplete combustion in stationary motor vehicles, fireplaces, stoves, and appliances using natural or liquid propane gas. Engineering and manufacturing improvements to lower carbon monoxide emissions have contributed significantly to reducing the rates of unintentional carbon monoxide fatalities.

Drowning

About half of all drownings occur during June, July, and August, when many people are engaged in summer water activities in swimming pools, lakes, rivers, and the ocean. Drowning occurs from the inhalation of water, which activates muscles around the throat to contract, thereby closing the main airway to keep water from entering the lungs. The muscle contractions continue as long as the person is under water; in a few minutes, it can lead to death by suffocation.

The widely held belief that swimming shortly after eating induces stomach cramps, thereby increasing the risk of drowning, is a myth. In actuality, after eating, blood is diverted to the stomach to assist digestion and consequently less oxygen may be available for muscles, which can lead to cramps in arm and leg muscles. This sequence poses no problem for a healthy person, but if a person is in poor health, is overweight, or has existing heart disease, the risk of drowning may be increased.





Many boating accidents—and subsequent drownings—are associated with drinking alcohol while having fun on the water.

© Ronnie Kaufman/DigitalVision/Getty Images

Alcohol and other drugs may be the biggest predisposing factors in drowning for individuals aged 15 and older. Impairment of the

individual's judgment may lead to the death of others as well, for example, operating a boat with passengers while intoxicated or drinking while supervising children who are in or near the water. Knowing your swimming ability and avoiding swimming in dangerous waters are ways to reduce the risk of accidental drowning. Using a personal flotation device (commonly called a *life jacket*) while you engage in water sports can also reduce the risk of drowning.

Choking and Suffocation

Each year in the United States more than a thousand people die because a piece of food or a foreign object becomes stuck in their throats and causes them to stop breathing. Common causes of choking and blockage of the air passage include food that is swallowed without being chewed sufficiently, swallowing small bones from fish or chicken, dentures, fillings, or loosened crowns. Being intoxicated also increases the risk of swallowing improperly.



Smoke Alarms Protect You from Fires

Smoke alarms in the home cut the risk of dying in a fire in half. The U.S. Consumer Product Safety Commission offers these suggestions about smoke alarms (<https://www.cpsc.gov/s3fs-public/559.pdf>):

- Install a working smoke alarm on every level of the home, outside sleeping areas, and inside bedrooms.
- Replace smoke alarm batteries at least annually (January 1 is an easy date to remember)
- Test all smoke alarms in your house once a month.
- Do not place a smoke alarm too close to a kitchen appliance or fireplace because it may result in nuisance alarms.
- Avoid locating alarms near bathrooms, heating appliances, windows, or ceiling fans.
- Manufacturers know what is best for their products and tell you how to care for them. Follow their instructions. Smoke alarms can save lives, but only if you install and maintain them properly.

- Keep your detector clean. Dust, grease, or other materials can interfere with efficient operation. You may want to vacuum the grill work on the detector.

Elderly adults, especially those with Alzheimer's disease, Parkinson's disease, or pneumonia, are particularly susceptible to choking on food, often because of a lack of saliva, either because of aging or as a medication side effect. To reduce the risk of the elderly choking on food, care should be taken in the preparation and consumption of hard candy, hot dogs, big pieces of meat, or large fruits like apples.

Young children are at risk for mechanical suffocation. A small child can become trapped or wedged into tight spaces, especially infants as they become more mobile and inquisitive. Long cords dangling from appliances, draperies, or blinds should be placed well out of the way of a curious infant or toddler. Other suffocation risks include bulky bedding materials and infant beanbag cushions.

Anything stuck in the throat blocking the air passage can stop breathing and cause unconsciousness and death within minutes. Do not interfere with a choking person who can speak, cough, or breathe, but if a conscious person cannot speak, cough, or breathe, perform the *Heimlich maneuver* (see the video at <https://www.youtube.com/watch?v=tEliEAn7b-U> or read the text at <https://medlineplus.gov/ency/article/000047.htm>). If the object is dislodged, take the person to a hospital immediately even if he or she seems all right. This is especially important if the swallowed object is a chicken or fish bone that may not have been completely dislodged. Also, if a bone has been swallowed, it can cause serious damage as it passes through the digestive system.

Fires

About 360,000 residential fires occur in the United States each year. Those fires are responsible for about 13,000 injuries and 2,500 deaths and a loss of \$7 billion. Fires in the home can be attributed to many factors: fireplaces, wood stoves, kerosene or space heaters,

improper placement of appliances, faulty wiring of the house or appliances, grease fires in the kitchen (loose sleeves dangling over open flames), improper storage of combustible materials, or a careless smoker in the house.

Deaths from fires can be prevented with the use of smoke alarms, portable ladders, and fire extinguishers. Each household should have a planned escape route, smoke alarms placed at key locations throughout the home, and posted emergency phone numbers. Everyone should know how to operate a fire extinguisher and know exactly where it is kept; in two-story houses, a portable ladder should be readily accessible. Many fire-retardant chemicals added to clothing, drapes, furniture, bedding, and other fabrics to help prevent the spread of a fire are toxic, posing a risk to health and to the environment.

Firearms

Access to a firearm increases the risk of a firearm-related injury or death. Owners of firearms should be trained in their use and take all possible safeguards to prevent intentional or unintentional injury or death. All firearms should be locked away and never be stored loaded. Ammunition should be kept locked in a separate location.

Among children younger than age 18, accidental or deliberate discharge of a firearm is the second leading cause of death behind car accidents. Every week about 50 American children die from a bullet wound. Add nearly 5,800 nonfatal gun injuries occur in this age group annually. The vast majority of firearm deaths among children is a result of playing with loaded guns or being present when family violence and homicide among adults occurs. Teens are just as likely to be killed by a firearm in a home or on the streets. Suicide by gun is almost always at home. The majority of children are killed with a handgun.

Nonpowder guns such as pellet rifles (BB guns) and paintball guns are thought to be harmless. These guns, powered by compressed air, are often given to children as gifts and are regarded as “toys.” However, they are far from harmless. Each year, about 20,000

Americans are treated in hospital emergency rooms for nonpowder gun injuries; most of those injured are children between 5 and 14 years old. The power of many of these guns can equal that of a 22-caliber rifle; when they are shot at someone at close range, they can kill, and several such deaths occur each year. Parents are advised not to let their children possess or use nonpowder rifles or pistols.



Protecting Kids from Firearm Death

Parents can take the following steps to help protect their children from death by firearm (University of Michigan Mott Children's Hospital, 2017):

- Parents who keep firearms at home should keep the guns locked and unloaded, with the ammunition locked in a separate location.
- Before a child goes to a friend's house, parents should ask the friend's parent whether the family has firearms in the house and how they are stored. This can be part of all the usual things you would discuss before a visit such as allergies, snacks, and sunscreen.
- Parents of teenagers should store guns safely to lessen the risk of gun suicide attempt, even if their children have been educated about guns.

Data from Fowler, K. A. (2017). Childhood firearm injuries in the United States. *Pediatrics*, 140, doi: 10.1542/peds.2017-2298



Prevent Computer-Related Injuries

People who daily spend many hours at a computer should take precautions to reduce the risk of injury, for example, by using an ergonomic chair and having the monitor and keyboard at comfortable positions. Monitor heights are also important (for information, see <https://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/office-ergonomics/art-20046169>). Take frequent breaks—for example, 5 minutes each hour to stand, stretch, or take a little walk.

Workplace Safety

In 2019, nearly 3 million workplace injuries required medical attention and about 4,800 people were killed (U.S. Bureau of Labor Statistics, 2021). Occupational injuries occur most often in manufacturing industries. Common occupational illnesses include skin disorders, respiratory conditions caused by inhalation of toxic substances, disorders associated with repeated trauma, poisonings, and dust-related diseases of the lungs. The actual incidence of these illnesses is suspected to be higher than reported because many workers do not seek medical attention for illness or injury. Agriculture has the highest incidence of skin diseases and disorders, which may be attributed to agricultural workers' close contact with pesticides, herbicides, and other chemicals.



Workers should always wear the appropriate safety equipment while on the job.

Courtesy of Photographer™s Mate Airman Paul H. Lavery Jr./U.S. Navy.

Carpal tunnel syndrome is one of a group of injuries known as **repetitive motion disorders** (also called *repeated trauma*) caused by stress on a body part from a repeated motion over long periods (**Table 17.2**). Symptoms of carpal tunnel syndrome are burning, numbness, tingling, and stiffness of the hand, fingers, or wrist. Dentists, dental hygienists, supermarket cashiers, seamstresses, musicians, factory workers, computer keyboard operators, and surgeons are at risk for carpal tunnel syndrome. Better product design, correct positioning of the operator and tool, and limiting the time spent at the same task can reduce the incidence of repetitive motion disorders.

TABLE 17.2 **Repetitive Motion Disorders**

<i>Repetitive Motion Disorders</i>	These injuries affect muscles, tendons, and nerves.
<i>Cervical Radiculopathy</i>	People who look up to a computer screen or who balance a phone on their shoulder are at risk.
<i>Pronator Syndrome</i>	Mechanics, baseball pitchers, and barbers are at risk.
<i>Carpal Tunnel Syndrome</i>	Typists, computer programmers, and potters are at risk.
<i>Thoracic Outlet Syndrome</i>	Violinists and other musicians are at risk.
<i>Cubital Tunnel Syndrome</i>	Truck drivers or other persons who keep their arms in fixed, flexed positions are at risk.



Be Your Own Best Friend

When the going gets tough, the tough. . . . What do you do?

A lot of college students meet life's inevitable challenges, pressures, setbacks, and failures with self-blame, harsh self-criticism, and imagined derogation by others—which makes them feel both physically terrible and terrible about themselves. If you're susceptible to self-criticism, when those "you're no good" thoughts and feelings arise, instead of beating yourself up, try being kind to yourself. Imagine that you are with a good friend who's hit a rough patch in life and is blaming herself for it. Would you say to your friend in the most critical way possible, "Yeah, you sure screwed up that one. How could you have been so stupid?" Of course you wouldn't. You'd probably feel sad or sorry for your friend and try to say something supportive and positive. Or maybe you'd just sit with your friend to let them know you are emotionally *there* with them.

The next time you're in a situation that's gone south—you know it will happen one day—try being your own best friend by not falling into the trap of harsh self-criticism and the resulting guilt and shame. As you would with a good friend, acknowledge that even though you feel bad, as a person you are OK and that this hurt and upset will pass. Even though the situation may be sucky, remind yourself that everyone goofs up from time to time, but that doesn't require being hard on yourself.

Take a break from thinking hurtful thoughts. Find a soothing place to sit or stand and focus your attention on the bottoms of your feet touching the floor or ground. Take two or three normal breaths. When thoughts arise, refrain from following them and instead focus your attention on the bottoms of your feet grounding you to the surface of Earth. Then take three or calming breaths (see Wellness Guide in Chapter 4). Inhale to the count of 4, hold your breath for a count of 5, and exhale with a count of 5. On each breath in think or say, "I am," and on each exhale think or say "OK." Feel compassion for yourself. You deserve it.

Sick building syndrome is an illness characterized by a variety of symptoms related working in building with no natural ventilation or poor ventilation systems, such as skyscrapers, warehouses, and old factories. Symptoms of sick building syndrome include asthma, lung infections, dizziness, nausea, throat and eye irritations, fatigue, cough, and shortness of breath. Major causes of sick building syndrome include outdoor pollutants such as dust, airborne

chemicals, auto emissions, and agricultural pesticides. Indoor causes include air conditioning contaminated by bacteria, molds, and other microorganisms and chemicals emitted from materials used in the construction of the building such as formaldehyde in plywood.

Interpersonal Violence

Interpersonal violence is physical or verbal behavior with the intent to harm, injure, or destroy someone or something. Very often, a reason for interpersonal violence is the fear of injury and death or a real or imagined threat of danger to one's or one's family, tribe, or community. Some people use interpersonal violence as a way to gain power over others. Interpersonal violence manifests as rape, intimate partner violence, child maltreatment, elder abuse, homicide, suicide, terrorist attacks, gang fights, and wars between nations.

About 19,000 persons die in the United States every year from homicide; 49,000 from suicide. More than 2 million persons are injured in violent attacks. Homicide is the second leading cause of death among persons aged 15 to 24, and suicide is the third leading cause of death in the same age group.

Firearm Violence

Firearm violence is nonmilitary violence committed with the use of a gun with or without criminal intent. Criminal gun violence includes intentional homicide (except if ruled justifiable) and assault with a deadly weapon. Noncriminal gun violence includes accidental or unintentional injury or death. The United States has the highest rate of firearm violence among peer nations (**Figure 17.5**).

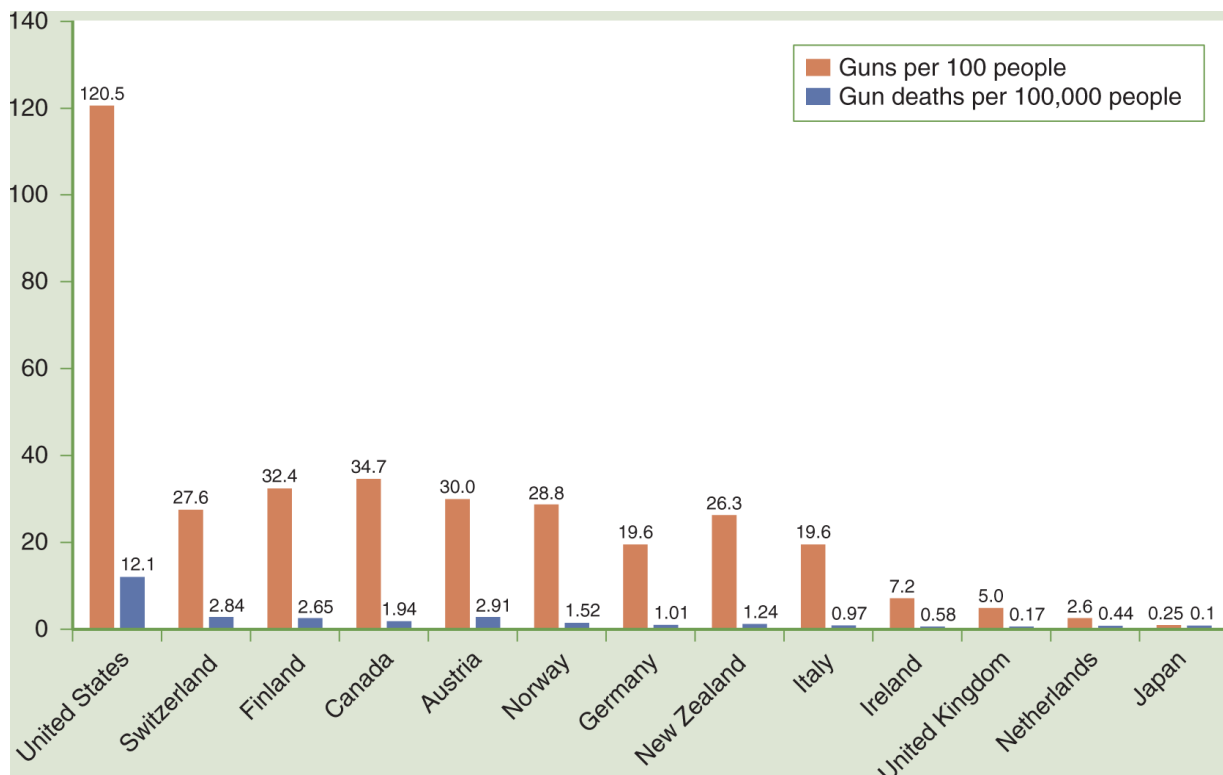


Figure 17.5 Rates of Firearm Violence Among Several Developed Countries.

Data from University of Sydney (Australia). Gun Policy Facts.

<https://www.gunpolicy.org/firearms/home>

Description

Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger

and are not fed, those who are cold and are not clothed.

—President Dwight D. Eisenhower (1953)

In response to recent mass killings at schools, movie theaters, nightclubs, and concerts, many Americans—gun owners and nongun owners alike—believe that gun violence is a huge problem in the United States, and many support strengthening gun control laws (Igielnik & Brown, 2017). For example, nearly 90% of gun owners and nongun owners favor preventing mentally ill persons from purchasing a gun; 80% favor barring those on no-fly lists from purchasing a gun; and more than 50% favor the creation of a federal database for tracking gun sales. Furthermore, many agree that a major cause of gun violence is the ease with which people can obtain guns. Research on firearm use suggests that more scrutiny of prospective gun buyers and more safety features on guns (such as fingerprint recognition) would reduce firearm violence.

Gun violence in the United States costs an estimated \$3 billion in medical costs and an estimated \$250 billion in other costs annually. That cost is an estimate because of a 1996 congressional rule that barred the Centers for Disease Control and Prevention from carrying out research on the public health consequences of gun violence. That rule was rescinded in 2019. Living in a house where there are guns increases the risk of homicide by about 170% and the risk of suicide by about 460% (Wintemute, 2008). States with the least strict gun ownership laws also have the highest rates of firearm-related deaths; states with stringent gun control laws have the lowest rates of firearm-related deaths (Fleegler et al., 2013).

Firearms are the second leading cause of death among young people between ages 10 and 24. A national survey found that 1 student in 12 admitted to carrying a firearm within the past month, either for defense or assault. People living in homes in which guns are kept have a risk of suicide that is five times greater than for people living in homes without guns. Surveys also show that the vast majority of teenage suicides are accomplished with guns.

Hate Crimes

A **hate crime** is an unlawful act that is motivated by hate or bias against a person, group, or place. Bombing a church, synagogue, or mosque because of the victims' faiths is a hate crime. Attacking any person because of his or her sexual orientation, gender identity, or nationality is a hate crime. In general, any act of **violence** that is motivated in whole or in part by prejudice against a victim's race, religion, ethnicity, gender, sexual orientation, disability, or age is a hate crime.

War is but a spectacular expression of our daily conduct.

—Krishnamurti

Hate crimes are prosecuted first as a particular crime and in addition a hate crime. Shooting at someone is assault. Shooting at someone because the offender carries a prejudice against that person's race, religion, occupation, or economic status is a hate crime. There is a difference between freedom of speech and a hate crime. Freedom of speech, no matter how offensive, is protected under the U.S. Constitution. Biased views and verbal attacks cannot be prosecuted as hate crimes. However, committing an act of violence because of hate or prejudice against what another says is a hate crime.

Elder Abuse

Elder abuse is defined as the physical, sexual, or emotional maltreatment or financial exploitation of an adult aged 60 or older. The abuse or neglect may be by a spouse, child, relative, professional caregiver, or friend. More than 1 million elderly persons are victims of abuse each year in the United States.

A variety of abusive methods are used by caregivers in the domestic setting to control the elder persons under their care. These include screaming and yelling (the most frequent form of abuse), physical restraint, forced feeding or medicating, blows and slaps, and threats to send the person to a nursing home.

However, the abuse is not all one way. Elder persons who are disabled or immobilized also use abusive methods to control their caregivers. Elder persons scream and yell, pout and withdraw, refuse food and medication, cry or become emotional, throw objects, and threaten to call the police. As with other forms of abuse, the reasons for the abusive behaviors by both persons in the relationship are many. Alcohol plays a role in many situations, and emotional illness contributes, as does mental impairment on the part of one or both parties.

Despite increased public attention to the problems of elder abuse, much maltreatment of elders still remains hidden to a large extent. The reason much elder abuse remains hidden or undocumented is that many elderly people are concerned about the family's privacy and fear public exposure and embarrassment. The victim also may feel shame at having raised a child who has now become abusive. If the child is stealing money, the elderly parent may fear that the child will be sent to jail if the abuse is reported. And, despite the abusive treatment, the elder person may feel that the situation is preferable to being sent to a nursing home.

Intimate Partner Violence

As previously noted, **intimate partner violence (IPV)** refers to physical, sexual, or psychological harm by a current or former intimate partner or spouse. Women are the most likely victims of IPV, but men also are affected. IPV is regarded as one of the most serious, preventable public health problems, affecting more than 32 million Americans at one time or another in their lives.

Several categories of IPV are recognized by health experts.

- *Physical violence*: the intentional use of physical force on another person that has the potential for causing injury, disability, or death. Physical violence may include scratching, pushing, kicking, punching, grabbing, biting, choking, and use of weapons.
- *Sexual violence*: (1) use of physical force to compel another person to engage in a sexual act against his or her will; (2) any sexual act against a person who is unable to understand the act or to indicate unwillingness to engage in a sexual act, for example, a person might be too drunk or intimidated to prevent the act; and (3) abusive sexual contact.
- *Threats of physical or sexual violence*: use of words, gestures, or weapons to communicate the intent to cause physical injury or death.
- *Psychological or emotional violence*: use of acts, threats of acts, or coercive measures that cause the victim to feel humiliated, embarrassed, diminished, or frightened; denying a victim access to friends, money, or food.

- **Stalking**: behavior that causes victims to feel a high level of fear of physical or sexual violence.

Because IPV is not discussed openly admitted or talked about by family members, or even by abused individuals, fewer than half of all cases of IPV are reported. But the extent of physical and sexual attacks on women in the United States is alarming (**Table 17.3**). More women are treated in hospital emergency rooms for IPV injuries each year than for muggings, rape, and traffic accidents combined. And battering during pregnancy is the leading cause of birth defects and infant mortality.

TABLE 17.3 | Estimated Number of U.S. Women Who Have Experienced Intimate Partner Violence

Violent Acts	Number
Rape	44.8 million
Sexual coercion	17.3 million
Unwanted sexual contact	34.2 million
Unwanted noncontact sexual experiences*	37.1 million
Physical violence	57.6 million
Psychological aggression by intimate partner	65.1 million

*Includes exposing sexual body parts, being made to look at or participate in sexual photos or movies, or being harassed in a public place in a way that felt unsafe.

Data from Smith, S., et al. (2017). *The National Intimate Partner and Sexual Violence Survey: 2010–2012 Summary Report*. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Retrieved from <http://www.cdc.gov/ViolencePrevention/pdf/NISVS-StateReportBook.pdf>

People who experience battering or rape by a partner or acquaintance not only have medical problems but also may suffer from anxiety, depression, chronic pelvic pain, gastrointestinal upset, substance abuse, obesity, headaches, and *posttraumatic stress disorder* (PTSD) and its variants, battered person syndrome or rape trauma syndrome. Symptoms of PTSD are described on the National Institute of Mental Health website, <https://www.nimh.nih.gov/health/topics/post-traumatic-stress-disorder-ptsd/>.

Many long-term health consequences are associated with battering, rape, and sexual abuse. For example, traumatized individuals tend to be more susceptible to arousal by stimuli that makes it difficult for them to differentiate normal aches, pains, and sensations from signals of disease, leading to increased incidence of seeking help from health professionals. Also, emotional upset and guardedness can produce painful muscle tension and skeletal misalignment. Chronic anxiety can lead to gastrointestinal upsets and immune deficiency. Alcohol, nicotine, and other drugs may be used to block out memories of abuse and to alleviate uncomfortable emotions and physical sensations that accompany memories of the assault or abuse.

Recovering from the trauma of IPV requires patience and support. Victims are encouraged to seek psychological counseling from professionals who specialize in helping people who have experienced intimate partner violence and to join support groups of other assaulted individuals. Support can hasten healing and recovery and help restore the trust that is shattered by assault. Support groups can also provide a place to stay if the victim needs to escape the abuser, or the group can offer companionship if the victim is afraid to be alone.



Hotline for Domestic Violence Help

Causes of Intimate Partner Violence

There is no single cause of intimate partner violence, but contributing factors include the following:

- A high level of conflict and stress in the family
- Male dominance and the view that women and children are men's property
- Cultural norms that permit family violence
- Displays of violence on TV and in other media
- Being raised in a violent family
- Alcohol and drug abuse
- Victim blaming ("people get what they deserve")
- Denying the existence of physical violence or sexual abuse

Women who are at the greatest risk for serious injury from IPV include those with male partners and former husbands and boyfriends who abuse alcohol or drugs, are unemployed or intermittently employed, and have less than a high school education.



Recovering from intimate partner violence almost always is a long-term process involving supportive professional counseling to help restore a sense of safety, facilitate personal psychological adjustment, and build positive social relationships.

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Ways to prevent IPV include providing shelters, safe houses, and other protective environments for abused women; reducing contributing social and economic factors (unemployment, poverty, and racism); holding the abusers accountable for their actions; training law enforcement and healthcare professionals to recognize and intervene in cases of IPV; training everyone in nonviolent conflict resolution; and reducing the amount of violent imagery on TV, in films, and in popular music. Physicians also are receiving more training in recognizing, treating, and helping with IPV—for example referring to a clinical specialist and helping to find a shelter. IPV also affects children who share an environment of IPV ([Table 17.4](#)).

TABLE 17.4 | Symptoms of Children Exposed to Intimate Partner Violence

Children who are exposed to IPV are subject to a variety of symptoms.

<i>Behavioral Symptoms</i>	Aggression Tantrums Immaturity Delinquency
<i>Emotional Symptoms</i>	Anxiety and depression Low self-esteem Anger Withdrawal
<i>Cognitive Symptoms</i>	Poor performance in school Poor language skills
<i>Physical Symptoms</i>	Eating disorders Psychosomatic disorders Poor motor skills Sleep problems Retarded growth

Maltreatment of Children

According to the World Health Organization (2020), **child maltreatment** is

the abuse and neglect that occurs to children under 18 years of age. It includes all types of physical and/or emotional ill-treatment, sexual abuse, neglect, negligence and commercial or other exploitation, which results in actual or potential harm to the child's health, survival, development or dignity in the context of a relationship of responsibility, trust or power.

Each year in the United States, more than 3 million documented cases of child maltreatment occur. It's believed that many more cases occur but are not reported. Among reported cases, about 17% are physical abuse, 8% are sexual abuse, and 75% are neglect. About five children die each day in the United States from neglect and physical abuse. About 2% of infants in the United States younger than the age of 1 suffer from neglect or abuse, often in the first few weeks of life. A large number of these cases are related to drug abuse by one or both parents.

A particularly disturbing form of child maltreatment is **shaken-baby syndrome (SBS)** in which infants are violently shaken by adults either to punish them or to stop them from crying. SBS affects as many as 1,400 infants each year. Shaken infants can be identified by physicians and trained personnel by a collection of symptoms that result from the violent shaking. Any kind of violent shaking of an infant is a crime. Shaking a baby repeatedly to get it to stop crying, or for any other reason, can cause death.

Child maltreatment involves one or more of the following:

Physical abuse: the use of physical force to discipline or control a child or adolescent that causes serious physical and psychological injury is child abuse. Often a parent or other adult is venting anger over something irrelevant to the child's behavior; the child is the unwitting victim of the anger and knows that the punishment is unjust. The younger the child, the more likely a serious injury will result from the use of physical force.

Psychological abuse: being punished unfairly, being screamed at repeatedly and told that one is worthless, stupid, or defective can permanently damage

psychological and social development.

Sexual abuse: sexual contact between adults and children. It is forbidden both by cultural taboos and criminal law. Sexual abuse of children may result in depression, anxiety, and general dysfunction later in their lives.

Neglect: probably the most common form of child maltreatment. Neglect includes failure to provide a child with adequate nourishment, proper clothing, and prescribed medications or to oversee a child's hygiene. Neglected children are left to their own devices for long periods without adult supervision, and many neglected children engage in self-destructive behaviors.

Child maltreatment affects children physically (e.g., broken bones, burns, or even death) and emotionally (e.g., aggressive, suicidal, anxious, or depressed). Effects are both short and long term and devastating to all the child and all concerned. As maltreated children reach age 10 or older and become more independent, they may feel themselves in a hopeless situation and run away from home. The consequences for many runaways are dismal: teenage prostitution, illicit drug and alcohol use, higher rates of juvenile crimes, and higher school dropout rates. Child abuse is costly to society and directly or indirectly affects everyone. Males tend to abuse children more than females do. Compared to female children, male children are abused more frequently, seen by parents as more deserving of harsh treatment, and blame themselves for their own maltreatment.

Preteen children are more vulnerable to maltreatment because they lack both physical strength to resist an abusive adult and an understanding of what is normal and abnormal behavior. Because of their special needs and the resultant stress on caretakers, children with physical or mental disabilities such as blindness, deafness, intellectual disability, or cerebral palsy are at a greater risk for child maltreatment than others. The same is true for children who are temperamental, impulsive, aggressive, depressed, or hyperactive.

Child maltreatment prevention programs emphasize educating parents on how to care for their children and how to avoid abusing them. Different stress-reduction programs have been developed for adolescent mothers, young parents, fathers who have never been in charge of childcare before, working mothers, single parents, stepparents, and siblings who are in charge of childcare. Stress-

management programs are particularly important in communities where unemployment rates are high.

Conflict-resolution programs can also help prevent child maltreatment. Being able to manage conflict without using physical force lowers the risk of child maltreatment. Both anger-mediation programs and conflict-resolution programs have been shown to help lower rates of child abuse. Training in life and social skills for all individuals involved with child abuse is recommended. Training in parenting skills for both males and females of all ages is also strongly suggested. This training also helps to educate participants about resources for assistance.

Sexual Violence

Sexual violence is any sexual act that is perpetrated against a person's will. Sexual violence includes a completed nonconsensual sex act (i.e., rape), an attempted nonconsensual sex act, abusive sexual contact (i.e., unwanted touching), and noncontact sexual abuse (e.g., threatened sexual violence, exhibitionism, verbal sexual harassment). All types involve victims who do not consent, who are unable to consent, or who are unable to refuse or disallow the act.

Rape and Sexual Assault

The word **rape** refers to nonconsensual sexual behavior, generally penile penetration of a bodily orifice. In the conduct of a rape, a victim also may be beaten, have her or his life threatened, or be killed. The combination of forced sexual penetration and nonsexual violence is **sexual assault**. Sexual assault is committed not for sexual gratification but for the desire to control, harm, humiliate, and dehumanize the victim.

In North America, rape and sexual assault are crimes. Although varying by jurisdiction, rape is generally defined as nonconsensual penetration by force or threat of force of a bodily orifice, including the mouth, rectum, or vagina. Penetration generally means by penis, although it also may include objects or other body parts such as fingers. *Nonconsensual* means the victim is incapable of giving legal consent because of mental development, physical disability, being intoxicated (e.g., with alcohol or drugs), or being unconscious. Types of rape include the following:

- *Date or acquaintance rape*: The victim and perpetrator know each other.
- *Marital rape*: The victim and perpetrator are married.
- *Stranger rape*: Forced sexual contact by a stranger.
- *Gang rape*: Rape by two or more perpetrators.
- *Statutory rape*: Sexual activity with a legally underage person.

According to the U.S. Department of Justice (Planty et al., 2016), approximately 300,000 adult American women and 90,000 adult American men report being raped each year. And because rape is largely an underreported crime, these data are thought to represent only about 40% of actual rape incidents. More than half of all rapes

of women (54%) occur before age 18; 22% of these rapes occur before age 14. Among men, 75% of all rapes occur before age 18, and 48% of these occur before age 14.

Because the vast majority of perpetrators of sexual assault are men, it is theorized that gender-role attitudes and expectations facilitate the occurrence of many rapes. For example, the belief that to be masculine is to be aggressive encourages some men to use sexual violence to gain control over others. This leads to expressions such as “women like a powerful man” and “women like being raped.” Also, some men believe that a sexual conquest proves masculinity. Believing that the male role is to be dominant, some men try to take what they want regardless of how their behavior may harm others. Moreover, some men receive support from male peers for sexually abusive behavior. The expectation that the male takes the lead in sex fosters misunderstandings and frustration. A woman’s “No” to a sexual advance can be misinterpreted as a signal to continue until finally the woman stops or pulls away, which frustrates the male and leads to anger-induced aggression. This gives rise to expressions such as “I didn’t believe her when she said no.”

Men who sexually assault women can be characterized either as anger motivated or power motivated. Anger-motivated assaults (about 20% of rapes) are generally motivated by an intense hatred of women. They tend to be committed by a stranger who threatens the victim with a knife or other weapon. Indeed, for victims, dying is a major fear during the attack. Perpetrators of power-motivated sexual assault (about 80% of rapes) are someone the victim knows who wants to control the victim rather than harm or injure her or him. The following are some common characteristics of sexual violence.

- Sexual violence is most often an attempt to control, harm, or overpower a victim; it is not motivated by sexual attraction, passion, or sexual deprivation.
- Most incidents of sexual violence are not reported to friends, family, or the authorities.

- Most incidents of sexual violence occur in the victim's immediate environment and are premeditated and planned.
- In most incidents of sexual violence, the perpetrator knows the victim.
- Sexual violence is perpetrated by people from all socioeconomic and educational levels and ethnic backgrounds.
- Victims do not secretly want to be sexually violated.

Acquaintance Rape

Acquaintance rape or date rape occurs when a person known to the victim uses verbal or physical force to coerce the victim into having sex. About 80% of rapes in the United States are committed by someone the victim knows. About half of all rapes occur on dates, at parties, or in other social situations. About 10% of American women are victims of rape or attempted rape in their lifetimes. Among men who are raped, more than half know their attacker. Acquaintance rape carries the same legal penalties as sexual assault committed by a stranger.



Many communities have crisis centers for rape victims.

Women of high school and college age are the most vulnerable to acquaintance rape. Every year, more than 100,000 forcible rapes are reported in the United States. This number is probably low because many rapes are not reported by victims.

Cultural views on sexual relationships between men and women play a significant role in acquaintance rape. Many young women who are victims of attacks that meet the legal definition of rape do not know that what happened to them was sexual assault. Victims may believe that a sexual assault can be committed only by a stranger or they may blame themselves for the act. A rapist may not realize that a victim's refusal really means *NO!* Aggressive males mistakenly believe that when women say no, men should insist. A significant proportion of men whose actions meet the legal definition of sexual assault believe they have not committed sexual assault.



How to Prevent Date Rape

- Be wary of a relationship that is operating along classic stereotypes of dominant male and submissive, passive female. The dominance in ordinary activities may extend to the sexual arena.
- Be wary when a date tries to control behavior or pressure you in any way.
- Be explicit with communication. Don't say "No" in a way that could be interpreted in any way as a "Maybe" or "Yes."
- Avoid ambiguous messages with both verbal and nonverbal behavior. Saying "No" and permitting heavy petting creates confusion or ambiguity.
- First dates with an unknown companion may be safer in a group.
- Avoid remote or isolated places where help is not available.
- Avoid becoming intoxicated while on a date.

How to Prevent Date Rape

Consequences of Acquaintance Rape

Victims of acquaintance rape often suffer serious, long-term psychological effects. Compared with victims of stranger rapes, acquaintance rape victims tend to blame themselves for what happened. They often have difficulty trusting people in later relationships. It may take acquaintance rape victims longer to recover, particularly if the rape involved physical violence. Acquaintance rape victims are less likely than other rape victims to seek crisis services, tell someone, report the incident to the police, or seek counseling. Family and friends may not provide the same support for acquaintance rape victims as they might offer victims of stranger rape. If victims tell friends or family, the severity of the attack may be minimized or the victim may be blamed for the sexual assault.

If a woman has had too much to drink or has been drugged and is unconscious, she cannot consent to any sexual act. Having sex with a woman who is unconscious or semiconscious is defined as an act of rape. Certain substances are known as *date rape drugs*. Rohypnol (also called “Roofies,” “rope,” “activesex”) is an odorless, tasteless compound that can be added to a person’s drink that will render the person unconscious. People who commit rape on drugged victims are sentenced to long terms in prison if convicted.

Consequences of Sexual Assault

Sexual assault can have many harmful and lasting consequences for victims, families, and communities. For example, being raped exposes victims to pregnancy and acquiring sexually transmitted diseases, including HIV/AIDS. Another common consequence is a sense of having been personally violated. Also, an assault victim may experience for months or years chronic pelvic pain,

gastrointestinal disorders, migraines and other frequent headaches, back pain, and facial pain. Victims may also be susceptible to alcohol and other drug abuse, principally to block out memories and anxieties associated with the attack. Common feelings reported by sexual assault victims are listed in **Table 17.5**.

TABLE 17.5 Feelings Reported by Sexual Assault Victims

Fear	Embarrassment	Shame	Guilt	Anxiety
<ul style="list-style-type: none"> • Fear of death • Fear of rapist 	<ul style="list-style-type: none"> • Embarrassed to discuss details • Embarrassed about their bodies 	<ul style="list-style-type: none"> • Destruction of self-esteem, self-worth, self-respect • Ashamed of having the medical exam • Ashamed of having to perform a sexual act to stay alive 	<ul style="list-style-type: none"> • Feelings of shame and of having provoked the rape • Feeling of blame for the assault 	<ul style="list-style-type: none"> • Shaking • Nightmares • Difficulty sleeping or sleeping all the time • Constantly reminds self what “should or shouldn’t have” been done
Stupidity	Vulnerability	Concern	Anger	Loss of Control
<ul style="list-style-type: none"> • Feels stupid for engaging in risk-taking behavior • Feels stupid for being too trusting 	<ul style="list-style-type: none"> • General fear of people • Paranoid feelings • Intensely heightened awareness of environment 	<ul style="list-style-type: none"> • Will the rapist get psychiatric help? • What will happen to offender if rape is reported? 	<ul style="list-style-type: none"> • Toward assailant • Toward self • Toward men and women in general, especially if they resemble assailant 	<ul style="list-style-type: none"> • Small decisions seem monumental • Unsure about self or actions

Description

Victims of sexual assault face both immediate and long-term psychological consequences, referred to as **rape trauma syndrome**. Immediately following an assault and continuing for days to several weeks, victims may display one of the three possible responses: (1) frequent crying and appearing agitated, hysterical, and anxious; (2) appearing calm and emotionally in control, as if nothing happened; and (3) shock and disbelief, being disoriented, confused, and unable to carry out normal tasks.

Recovering from sexual assault requires patience and support. Sexual assault survivors are encouraged to seek psychological counseling from rape-recovery or trauma professionals. Also, joining a support group of other assaulted individuals can be helpful in

releasing the shame and horror associated with the assault. Support and understanding from family, friends, intimate partners, and the community are also valuable.

Sexual Violence at American Colleges and Universities

According to the American College Health Association (2020), each year about 3% of American college women and 1% of American college men experience attempted or completed sexual assault against their will. Approximately 90% of sexual assaults on college campuses are committed by someone the victim knows. Most acquaintance rapes occur when people involved are at a party or studying together in a dorm room. College students are the most vulnerable to acquaintance rape during the first few weeks of the freshman and sophomore years. Actual *date rape* tends to occur at the beginning of a dating relationship.

Acquaintance rape among college students is sometimes interpreted as a result of miscommunication between those involved. This theory holds that men are socialized to believe that women initially resist sexual advances to preserve their reputation as “moral”; because of this, they prefer to be overcome sexually. If a woman says “No,” a man is to proceed as if she said “Yes.” In addition, some men believe that if a woman is labeled or perceived as a *tease* or *loose*, she is asking for sex. Men view certain cues as evidence that a woman is interested in having sex: wearing revealing clothing, agreeing to go to his room, or complimenting the man during the date.

Alcohol use among offenders, victims, or both is associated with most rapes among college students. Alcohol can reduce the capacity to verbally or physically resist a rapist.

College acquaintance rape victims suffer the same psychological harms as other rape victims. In addition, college acquaintance rape victims may leave school for fear of facing their attacker on campus.

Many victims, perpetrators, and others in the campus community often do not interpret forced sex by a victim’s dating partners or intimate partner as criminal sexual assault. They believe the myth

that rape is only committed by strangers. Thus, forced sex by an acquaintance is something other than rape.

What to Do After a Sexual Assault

A person who has been sexually assaulted is advised to do the following:

- Contact a rape-crisis hotline.
- DO NOT shower, bathe, douche, change or destroy clothing, or straighten up the area where the sexual assault occurred (if indoors) because these actions would destroy important evidence.
- Go to the nearest hospital emergency room.
- Notify the police.
- Seek professional counseling.

Each person's reaction to being sexually assaulted is different, and it is natural that each victim's pain and needs are unique. All victims of sexual assault should seek counseling from someone they trust.

Critical Thinking About Health

1. Alcohol is a contributing factor in about half of motor vehicle fatalities. What are your campus and community doing to help prevent people, both young and old, from driving while intoxicated? Some questions to consider:
 - Are there educational programs? If so, what are they and whom do they target?
 - How would you design an educational program to keep your peers from drinking and driving?
 - Are there seasonal programs that increase awareness about the dangers of drinking and driving (e.g., high school prom, Fourth of July)?
 - What is the role of local law enforcement, both on and off campus, with regard to decreasing drinking and driving accidents and fatalities?
2. Federal, state, and local governments have written and passed laws and regulations that enforce certain safety behaviors that have an impact on the individual or community. Such laws regulate using a seat belt, restraining your child in a car seat, and wearing a helmet while riding a motorcycle or bicycle. Some people believe that the government (at any level) should not mandate laws regarding individual safety and injury prevention. Others believe that the government has a right to demand certain safe behaviors among its citizens for the public good. What's your opinion? Should the government be allowed to regulate individual safety behaviors? Explain why or why not.
3. The rate of firearm homicide in the United States, nearly 4.1 gun deaths per 100,000 population, is far higher than in any of its peer countries: Canada, 0.5; Italy, 0.35; Sweden 0.25; Australia, 0.18; Germany, 0.08; United Kingdom, 0.04, Japan, 0.02 (University of Washington's Health Metrics and Evaluation,

<http://www.healthdata.org/acting-data/gun-violence-united-states-outlier>). Offer an explanation of that finding, the reasons for it, and how the United States could reduce its homicide rate to the level of its peer countries.



Preventing Sexual Assault

- When you go out, always take your (charged) cell phone and \$30–\$50 for emergency transportation. Tell someone where you are going.
- Trust your feelings. If you feel you are in danger, get yourself to safety immediately. If you are confronted, blow a whistle or yell “FIRE.” Do not yell “help” or “rape” as people are more likely to respond to a general emergency than an assault.
- Be aware of your surroundings. Know where you are going.
- Stay in well-lit areas. Use a shuttle service after dark. Never walk alone at night and avoid taking roads or paths where there are few people.
- After entering your car, do not dawdle. Drive away immediately.
- Do not leave a party, concert, game, or other social occasion with someone you just met or do not know well.
- Always travel in groups.
- Check out a first date or a blind date with friends. Insist on going to a public place such as a movie, sporting event, or restaurant and meet the person there and not at your residence.
- Avoid targeting yourself by not allowing your photo and personal information to be published for distribution on social media or the Internet.
- Think about how close you want to get to the person with whom you have a relationship and clearly state your limits.
- If someone is coming on to you forcefully, say “NO” firmly and with force. Don’t try to protect that person’s feelings; don’t smile; use the word *rape* to show what is really going on. Get away or scream if you assess it is safe to do so. Lie if you must. Say you have herpes, gonorrhea, or some other transmissible disease.
- Avoid date rape drugs such as Rohypnol, GHB, and ketamine. Pour and prepare all drinks you consume (alcoholic and nonalcoholic).
 - Do not leave your drink alone on the table or bar.
 - Keep your hand over the bottle or top of your glass.
 - Do not drink out of large, open containers, such as punch bowls.
 - Do not trade or switch drinks with others.
 - Do not drink something if it looks or tastes “different.”

- Watch for signs of drug effects in friends and help them.

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Many times during your life you will have an accident. Certain activities create opportunities that increase the likelihood of an accident—for example, driving a car, riding a bicycle or motorcycle, and using a power tool while turned or after having a couple of beers. Because automobile, motorcycle, and bicycle accidents are frequent and the injuries suffered often serious, society devotes considerable effort and money to reducing accidents and mitigating injuries for these activities. Seat belts and air bags reduce injuries in a car crash; helmets and special clothing reduce injuries in bicycle and motorcycle accidents. A federal government agency monitors and enforces regulations that are designed to reduce workplace accidents. Workers may be required to wear special hats, masks, gloves, or clothing to reduce injuries from accidents. Companies are required to educate workers on safe practices and to provide a safe working environment. Sadly, safe practices are not always followed. In 2014, the owner of a coal mine was charged with murder for operating an unsafe mine in which more than a dozen miners died in a series of underground explosions. Overall, the coal industry owes the U.S. government more than \$70 million in unpaid fines for violation of safety rules.

Just because accidents occur frequently does not mean they are inevitable. You can increase or reduce your personal risk of an accident by your overall lifestyle and by how careful you are while performing hazardous tasks. You cannot and should not live your life in fear of accidents. Trying something new involves risk. You should decide, however, how much risk you are willing to take and engage in activities with which you feel relatively safe. When you are doing something for the first time or something that you know is dangerous, remind yourself to *Be Careful*.

There is no sugarcoating the facts. American society is more violent than other developed countries in the world. Per capita, the United States reports more homicides than other developed countries with large populations. Date rape has become so pervasive that most colleges have instituted programs and policies to stem rapes on and around their campuses. Police resort to excess violence time after time in city after city in the guise of “keeping the peace.” Can we discern why American society accepts and tolerates so much violence?

The human species has a long history of violence. It may have contributed to the survival of those who lived in an environment of “kill or be killed.” But uncontrolled violence poisons a modern society. What would cause someone to become violent enough to beat, rape, or shoot another person? Ask yourself if you have a problem with anger, drugs, alcohol, or any condition that might cause you to commit a violent act. Violence is reduced one person at a time, one day at a time, one incident at a time.

Live a life in which you do not have to resort to violence. If a majority of people in the United States became advocates of nonviolence, society would change. It might mean the end of war as a way to resolve differences. Is that so bad?

HIGHLIGHTS

- Many factors contribute to unintentional injuries: knowledge, attitudes, beliefs, and behaviors; economic and social factors; competence; environmental conditions; and use of alcohol and other drugs.
- The Haddon Matrix was developed to assess motor vehicle risk factors and is used to develop prevention programs.
- A multidimensional approach to injury prevention includes education, prevention strategies, stricter laws and regulations,

and better product design.

- One motor vehicle death occurs every 12 minutes.
- Alcohol is involved in more than half of all motor vehicle accidents.
- Motorcycle, all-terrain vehicles, and bicycle safety rules and equipment are keys to preventing accidents. Wear reflective clothing and obey safety rules.
- Safety in the home includes preventing falls, poisonings, drownings, choking, and fires.
- Proper work safety procedures can prevent the majority of work-related injuries.
- Accidents and injuries are a consequence.
- Intimate partner violence includes relationship abuse and child abuse. *Violence* refers to use of force and power.
- Child maltreatment encompasses physical abuse, emotional abuse, sexual abuse, and neglect.
- People who have been assaulted may experience anxiety, depression, substance abuse, headaches, and other medical problems. These are symptoms of posttraumatic stress disorder (PTSD). Many long-term consequences of sexual abuse are associated with PTSD.
- Acquaintance rape or date rape occurs when a person known to the victim uses force or power to coerce the victim into having sex. Women of high school and college age are most vulnerable to acquaintance rape.

- Child maltreatment is a form of domestic violence that reaches across all social, economic, racial, ethnic, geographic, and educational barriers.
- Education is the key to all forms of violence prevention, including firearm violence, relationship abuse, acquaintance rape, and child abuse.

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KEY TERMS

unintentional injury:

preferred term for accidental injury; result of an accident

accident:

sequence of events that produces unintended injury, death, or property damage; refers to the event, not the result of the event

accident mitigation:

methods to reduce damage caused by unplanned events

accident prevention:

ways to eliminate the occurrence of unintended injuries

injury epidemiology:

the study of the occurrence, causes, and prevention of injury

traumatic brain injury (TBI):

injury caused by a bump, blow, or jolt to the head that results in impaired thinking or memory, altered movement or sensation, personality changes, or emotional problems such as depression

poison:

any chemical substance that causes illness, injury, or death

repetitive motion disorders:

disorders caused by repeated stress to a body part; carpal tunnel syndrome is a repetitive motion disorder

sick building syndrome:

collection of symptoms reported by workers in some modern buildings

interpersonal violence:

physical or verbal behavior in which the intent is to harm, injure, or destroy someone or something

firearm violence:

nonmilitary violence committed with the use of a gun with or without criminal intent

hate crime:

any unlawful act committed against a person, group, or place that is motivated by hate or bias

violence:

a physical or verbal behavior in which the intent is to harm, injure, or destroy someone or something

elder abuse:

physical, sexual, or emotional maltreatment or financial exploitation of an adult aged 60 or older

intimate partner violence (IPV):

physical, sexual, or psychological harm by a current or former intimate partner or spouse

stalking:

behavior that causes victims to feel a high level of fear of physical or sexual violence

child maltreatment:

physical or mental injury, sexual abuse or exploitation, maltreatment, or neglect of a child by a person who is responsible for the child's welfare

shaken-baby syndrome (SBS):

a form of child abuse in which an infant is violently shaken by an adult

sexual violence:

violent actions that include rape, incest, attempted rape, and unwanted sexual touching

rape:

nonconsensual sexual behavior, generally penile penetration of a bodily orifice

sexual assault:

the combination of nonconsensual sexual penetration (rape) and nonsexual violence, such as battery, the threat of harm, or homicide

acquaintance rape:

(also known as “date rape”) sexual assault occurring when the victim and the rapist are known to each other and may have previously interacted in some socially appropriate manner

rape trauma syndrome:

Immediate and long-term psychological difficulties, including PTSD, from having been raped



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CHAPTER 18

Working Toward a Healthy Environment



Health Tips

Where You Live Can Affect Your Health

Dispose of All Mercury Thermometers Safely

Compact Fluorescent Light Bulbs Contain Mercury

Good Riddance to the Plastic Bag

Precautions for Pesticide Use

Ways to Reduce Your Exposure to EMFs



Dollars & Health Sense

Bottled Water Battles

Plastic Microbeads and Microfibers Pollute Oceans and Seas



Global Wellness

Gaia: Can Earth Regulate Itself?

Wind-Based Electrical Power



Wellness Guide

Harmony and Peace

LEARNING OBJECTIVES

1. Discuss the relationship between environment and health.
2. Describe the health effects of air pollution, including smog and the hole in the ozone layer.

3. Explain the greenhouse effect and the predicted consequences of global warming.
4. Describe the effects of lead on children's health and intelligence.
5. Describe substances that pollute water in the United States.
6. Discuss the impact of land pollution on food production and health.
7. Describe sources of pesticide contamination and their effects on health.
8. Explain the effects of endocrine disruptors.
9. Identify the potential health problems associated with noise pollution and electromagnetic fields.
10. Discuss how human population growth affects global health and environmental issues.

The term **environment** refers to all external physical factors that affect us. To survive and achieve optimal health, we must live in a high-quality environment. Unfortunately, many aspects of the worldwide environment are deteriorating.

- The globe is warming from increased amounts of carbon dioxide, methane, and other pollutants in the atmosphere. Global warming will alter climate patterns, raise sea levels and flood coastlines, imperil the world's food supply, increase the frequency and distribution of infectious diseases, and create extremes in the weather.
- Land is being degraded by deforestation, desertification, and soil erosion. Land degradation undermines the ability of populations to grow food and protect freshwater supplies.
- Freshwater shortages are being caused by overpopulation, a lack of modern sanitation in parts of the world, and outmoded irrigation practices.
- Air is being polluted from the burning of fossil fuels by industry and cars and trucks. Pollutants foul the air and cause respiratory disease, destroy forests and lakes by acid rain, and destroy

atmospheric ozone, which increases the risk of cancer and other biological damage.

- Exposure to toxic industrial and agricultural chemicals causes cancer and disrupts normal biological functions in humans, animals, microorganisms, and plants.
- Species are being sent into extinction from global warming, the destruction of tropical rain forests, overhunting and overfishing, habitat destruction from human activity, and the introduction of nonnative species into new environments.
- Nuclear, chemical, and biological problems are the result of industrial pollution and accidents.

Through the enactment and enforcement of environmental laws and regulations, the countries of the world must continue emergent efforts to reduce environmental pollution and their negative health consequences. However, governments and other organizations alone cannot solve environmental problems. Each individual must strive to reduce or eliminate air, water, and land pollution and take steps to create a healthy environment.

Outdoor Air Pollution

Pure air is essential for healthy human life. Each of us breathes about 35 pounds of air per day—more than 6 tons over the course of a year. Fresh, clean air consists of about 21% oxygen, 78% nitrogen, and trace amounts of seven other gases. It is the oxygen in air that is essential for human life. If the oxygen content of the air drops below 16%, body and brain functions are impaired. If breathing stops for even a few minutes, a person becomes unconscious and will die unless breathing is quickly restored.

Since the beginning of the industrial revolution in the late 18th century, the burning of fossil fuels (coal, oil, and natural gas) to power transportation and industry has progressively polluted the air with carbon dioxide, oxides of nitrogen and sulfur, soot, and small particles, some of which cause health problems. A variety of chemical substances used in modern societies pollute the air as well (e.g., chlorofluorocarbons, dioxin). Thus, technological advances over the two and one-half centuries have created, as a by-product, pollution of the air we breathe and of Earth’s atmosphere ([Table 18.1](#)).

TABLE 18.1 Major Air Pollutants and Their Health Effects	
These pollutants affect breathing, damage lungs, and cause a wide range of health problems. The primary sources of these air pollutants are industrial emissions, automobiles and trucks, and coal and oil burning in industry and homes.	
Pollutant	Health Effects and Symptoms
Carbon monoxide gas	Low levels cause dizziness, headache, and fatigue. High levels lead to coma and death. It is especially dangerous for persons with asthma and heart disease.
Carbon dioxide (CO ₂)	This is a major contributor to global warming. Since 1970, yearly CO ₂ emissions have increased 1% to 2% per year,

	reaching an all-time high in 2017.
Nitrogen oxide gas	Causes a smelly brown haze that irritates the eyes, nose, and lungs.
Sulfur dioxide gas	Sulfur dioxide gas is poisonous and irritates the eyes, nose, throat, and lungs. It kills plants and rusts metals.
Particulate matter (particles from dust and smoke that are less than 10 microns in diameter)	Causes throat irritation and permanent lung damage. Some industrial soot particulates may cause cancer.
Ozone (O ₃)	In the stratosphere, ozone protects us from UV light. Can be formed at ground level from nitrous oxides and organic compounds. Causes eye irritation, coughing, and breathlessness.
Volatile organic compounds	Smog-forming chemicals, such as benzene, toluene, methylene chloride, and methyl chloroform. All VOCs can cause serious health problems.



Gaia: Can Earth Regulate Itself?

Life on Earth depends on a precise range of climatic and chemical conditions. On a global scale, the temperature and the chemical composition of air, land, and water, as well as other natural processes we take for granted, must be relatively constant for life to survive. Since the dawn of the industrial revolution in the late 18th century, human activity has been altering the chemical balance of Earth, and it remains to be seen to what extent Earth can tolerate these alterations.

In 1979, James E. Lovelock, an English chemist and engineer, published a book called *Gaia: A New Look at Life on Earth*, which proposed that a special, interdependent relationship exists between life (particularly human beings) and all the physical and chemical processes of the planet required to sustain biological life. Lovelock suggested that, in a sense, Earth was “alive” and chose the name of the Greek goddess of Earth, *Gaia*, to express the idea of a living planet. Lovelock described Gaia as “a complex entity involving the Earth’s biosphere, atmosphere, oceans, and soil; the totality constituting a feedback or cybernetic system which seeks an optimal physical and chemical environment for life on this planet” (Lovelock, 1979).

The idea that Earth is a self-regulating system may be correct; however, there is little indication that people will alter their mistreatment of Earth any time soon. So, in a way,

the Gaia hypothesis will be tested and all the world will see the results. Either Earth can adapt to the effects of human activity, or it cannot. If it cannot, it is not unreasonable to predict that humans will become extinct. Extinction has been the fate of virtually all species that ever existed on Earth. Even the dinosaurs, who survived for about 150 million years, eventually became extinct.

Smog

Everybody has heard of **smog**, a term first used in England to describe a hazardous combination of the water vapor in fog and sulfurous chemicals emitted into the air from the burning of coal. Smog causes breathing problems, coughs, bronchitis, and asthma and can even result in death among people with lung or heart diseases. In most U.S. cities, smog is not associated with fog but results from the action of sunlight on various chemicals and particles in the air that come from automobiles, oil refineries, electricity-generating plants, and other industrial sources. This is why it is called **photochemical smog**. Photochemical smog consists of ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen oxides, particulates, and volatile organic compounds.

Ground-Level Ozone

Ozone (O_3) consists of three atoms of oxygen, as compared with the oxygen we breathe, which consists of two atoms of oxygen (O_2). Whereas ozone in the upper atmosphere benefits life on Earth by shielding it from harmful ultraviolet radiation from the sun, high amounts of ozone at ground level are a major health hazard. Ground-level ozone is not emitted directly into the air from polluting vehicles or industries. Instead, it is formed when sunlight acts on two other pollutants, volatile organic compounds (VOCs) and oxides of nitrogen (nitrogen oxide and nitrogen dioxide).

Ozone can damage lung tissue, reduce lung function, and sensitize the lungs to other irritants. Exposure to even relatively low amounts of ozone for several hours can induce respiratory inflammation in healthy people during exercise. This decrease in lung function generally is accompanied by chest pain, coughing,

sneezing, and pulmonary congestion. Ozone's effects on people with impaired respiratory systems, such as asthmatics, is usually more severe.



Where You Live Can Affect Your Health

Living in a region with air polluted with industrial and automobile combustion waste is not only a nuisance but also a threat to life. Each year, more than 4 million people worldwide die prematurely from having to breathe air made toxic from industrial and auto pollution (Landrigan et al., 2017).

According to the American Lung Association's annual report State of the Air 2021 (<https://www.lung.org/research/sota>), in the United States, about 40% of the population lives in regions that have year-round unhealthful levels of either ozone or particulate pollution, or both. Most of these high-pollution regions are in the Western states because of climate (high atmospheric pressure inversions), reliance on automobile transport, and exposure to smoke and soot from wildfires and wood-burning fireplaces. In the middle and eastern parts of the United States, high air pollution is the result of industrial emissions from coal-fired power plants, refineries, and diesel-powered transportation. Note that several regions of the country have extremely good quality air, including Burlington–South Burlington, Vermont; Charlottesville, Virginia; Elmira–Corning, New York; Honolulu, Hawaii; and Wilmington, North Carolina.

Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, poisonous gas produced by incomplete burning of carbon-containing materials. Three-fourths of CO emissions in the United States are from transportation sources, mostly motor vehicle exhaust. Other major CO sources are wood-burning stoves, incinerators, and industries.

When CO enters the bloodstream, it reduces the amount of oxygen that can be delivered to the body's organs and tissues. Exposure to high levels of CO can cause impairment of visual perception, manual dexterity, learning ability, and performance of complex tasks. If the air contains 80 parts per million (ppm) of CO, the oxygen supplied to the body is reduced by 15%. In heavy freeway traffic, the levels of carbon monoxide may reach 400 ppm. It

is no surprise that many commuters in large cities who get stuck in traffic jams arrive home with headaches. Car mechanics and parking garage attendants, who are exposed to high levels of carbon monoxide for long periods, may develop health problems. Health threats from CO are most serious for those with heart disease.

Sulfur Dioxide

Sulfur dioxide (SO₂) is produced when gasoline, diesel fuel, and coal or oil, all of which contain sulfur, are burned in cars, trucks, power plants, and industrial and home heating systems. Sulfur dioxide also is produced by active volcanoes. Sulfur dioxide can mix with water vapor in the air to form *acid rain*, a highly corrosive substance that can erode stone, pit metal, and damage living tissue. It also damages aquatic ecosystems and forests in many parts of the world. Exposure to SO₂ makes breathing difficult and aggravates existing respiratory and cardiovascular diseases.

Nitrogen Oxides

The major sources of nitrogen oxides are transportation, electric power plants, and industrial boilers. Nitrogen oxides consist principally of nitrogen oxide (NO) and nitrogen dioxide (NO₂). In photochemical smog, nitrogen oxide is converted to NO₂, which is a brownish, highly reactive gas that can irritate the lungs and pave the way for bronchitis, pneumonia, and other respiratory infections. Nitrogen oxides also contribute to ground-level ozone and acid rain, and they may alter both terrestrial and aquatic ecosystems.



Polluted, smoggy air over many large cities contributes to respiratory problems and other diseases.

© Yenwen/E+/Getty Images

Particulate Matter

Particulate matter (PM) consists of microscopic particles released into the air principally from the burning of diesel fuel, coal, and other fossil fuels. Particulate matter causes the haze associated with photochemical smog and damaging soil and structures in the process. When inhaled, particulate matter damages the respiratory system and impairs breathing; the particles also aggravate existing respiratory and cardiovascular diseases.

Particulate matter is classified as either PM 2.5, which means the size of the particles in the particulate matter are about 2.5 micrometers (PM_{2.5}), and PM₁₀, in which particle size is about 10 micrometers (PM₁₀). A grain of fine beach sand has a diameter of about 90 micrometers. The composition of PM_{2.5} particles includes emissions from gasoline and diesel engines, metals, and organic

compounds, as well as from other sources. The composition of PM₁₀ particles includes dust, pollen, mold, and other substances. Particle measurements are made in these two size ranges for convenience; in reality, however, air is polluted with particles of all sizes ranging from invisible nanoparticles to large particles originating in dust storms and from forest fires. Urban and industrialized areas have more air pollution from particulate matter than is found in rural areas.

The size of particulates is directly related to their potential for causing health problems. Particulates smaller than 10 micrometers in diameter (PM₁₀) pose the greatest problems because they can get deep into the lungs, and a percentage of those enter the bloodstream and travel to other parts of the body. Particulate pollution is related to a variety of health problems, particularly on days when air pollution is high. The health problems associated with particulate pollution include death in people with heart or lung disease, heart attacks, irregular heartbeat, asthma attacks, decreased lung function, and coughing or difficulty breathing. People with heart or lung diseases, children, and older adults are the most likely to be affected by particulate exposure. Air pollution is the 13th leading cause of mortality worldwide.

Volatile Organic Compounds

Volatile organic compounds (VOCs) are chemical substances that exist in the air as gases. About 50% of VOCs come from industrial and commercial processes such as oil refining, printing, painting, and dry cleaning. Another 40% of VOCs come from motor vehicle exhaust. Five percent comes from power generation, and the rest from miscellaneous sources. In the presence of sunlight, some VOCs (called *ozone precursors*) easily combine with other air pollutants to form ground-level ozone.

Besides contributing to photochemical smog, some VOCs are harmful to human health and are classified as hazardous air pollutants. VOCs cause eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to the liver, kidneys, and central nervous system. Some are suspected of causing or are

known to cause cancer. The ability of VOCs to affect health depends on their innate toxicity and the degree and length of a person's exposure.

Children and Air Pollution

Children who live in regions of high air pollution suffer a 10% to 15% decrease in lung function as compared with children who grow up where the air is less polluted. Early exposure to polluted air can damage the respiratory tract and increase the risk of respiratory disease in adult life. Children are much more likely than adults to develop pollution-related lung damage because they inhale several times more air than adults, and they breathe faster, particularly during strenuous physical activity. In addition, they spend more time outdoors than any other segment of the population. The lungs in children and adolescents undergo steady development, with peak lung capacity reached between ages 20 and 25. Lung capacity remains stable for another 10 years and then gradually declines with age. Breathing polluted air while the lungs are still developing can decrease lung function later in life and contribute to the development of asthma, chronic obstructive lung disease, and cardiovascular disease.

Improving Air Quality

In 1970, the U.S. Congress passed the Clean Air Act, which created the Environmental Protection Agency. Since that time, Americans have supported a substantial reduction in air pollution. Between 1970 and 2019, the combined emissions of the six common pollutants (PM_{2.5}, PM₁₀, sulfur dioxide, nitrogen oxides, volatile organic compounds, carbon monoxide, and lead) decreased by 77%. To those who claim curbing environmental pollution harms the U.S. economy, these dramatic reductions in pollution occurred while the U.S. gross domestic product increased 285%, Americans drove 195% more miles, the U.S. population grew 60%, and energy consumption increased 44% (U.S. Environmental Protection Agency, 2020).

In 2003, the world got a preview of what could happen to air quality when energy is produced via renewable technologies (solar, wind, ocean) instead of polluting and health-risking technologies such as coal, oil, natural gas, and wood. On August 14, technology glitches led to the largest electrical power blackout in North American history, affecting the northeastern United States and Canada. Approximately 40 million people in eight U.S. states (about one-seventh of the population of the United States) and 10 million people in the Canadian province of Ontario (about one-third of the population of Canada) were impacted. Air samples collected over Pennsylvania a day after the shutdown of all power plants in the region showed a 90% reduction in sulfur dioxide and a 50% reduction in ozone. Visibility increased 25 miles. Suddenly the air was no longer hazy (Ball, 2004).

Prior to the 2008 summer Olympics in Beijing, the Chinese government took unprecedented steps to reduce the severe air pollution that covers the city almost constantly. In the years before the Olympics, the government planted millions of trees in and around the city. In the months leading up to the Olympics, the government ordered the shutdown of air-polluting industries for hundreds of miles around the city. Construction in Beijing was halted, and traffic was sharply curtailed. Although not producing crystal clear air, these efforts significantly improved air quality during the 2008 Olympics. This example shows that reducing air pollution is a matter of will and not a lack of technical know-how.

The elimination of lead in gasoline was a major victory in the battle against air pollution. The phaseout of leaded gasoline, which began in 1984, has markedly reduced the blood levels of lead in the U.S. population. The effort to eliminate lead in gasoline took more than 10 years to accomplish because industry feared financial losses and resisted the change.

Carbon Dioxide, Global Warming, and Climate Change

Along with the gases oxygen (O_2) and nitrogen (N_2), carbon dioxide (CO_2) is a natural component of Earth's atmosphere. Plants use carbon dioxide to manufacture more plant material and give off oxygen that animals breathe in the process. Carbon dioxide in air also is absorbed into oceans, where it forms carbonate-containing rocks for coral and other sea life.

Before the industrial revolution, the level of carbon dioxide in the atmosphere was fairly constant at about 290 parts per million (ppm). In the ensuing years, because humans began burning coal, oil, and wood in vast quantities to fuel modern life, the level of atmospheric CO_2 rose to about 315 ppm by 1950. In early 2021, atmospheric CO_2 levels reached an all-time high of about 416 ppm. The rate of increase in CO_2 levels in the atmosphere is now about 2.5 ppm per year (U.S. National Oceanic and Atmospheric Administration, 2021).

In 1861, an English scientist pointed out that carbon dioxide is a good absorber of infrared (heat) radiation. When sunlight lands on Earth's surface, some of the energy in the light is radiated back toward space as infrared radiation or heat. Carbon dioxide absorbs the infrared radiation and thereby traps heat in the atmosphere. Because this process is analogous to how a garden greenhouse works, this phenomenon is called the **greenhouse effect** (**Figure 18.1**). It became apparent in the 1990s that Earth's temperature is increasing (**Figure 18.2**) and that it is *not* from natural fluctuations in the global climate; nearly all climate scientists now believe that the rise in global temperature is caused principally by increased levels of human-generated carbon dioxide (Intergovernmental Panel on Climate Change, 2021).

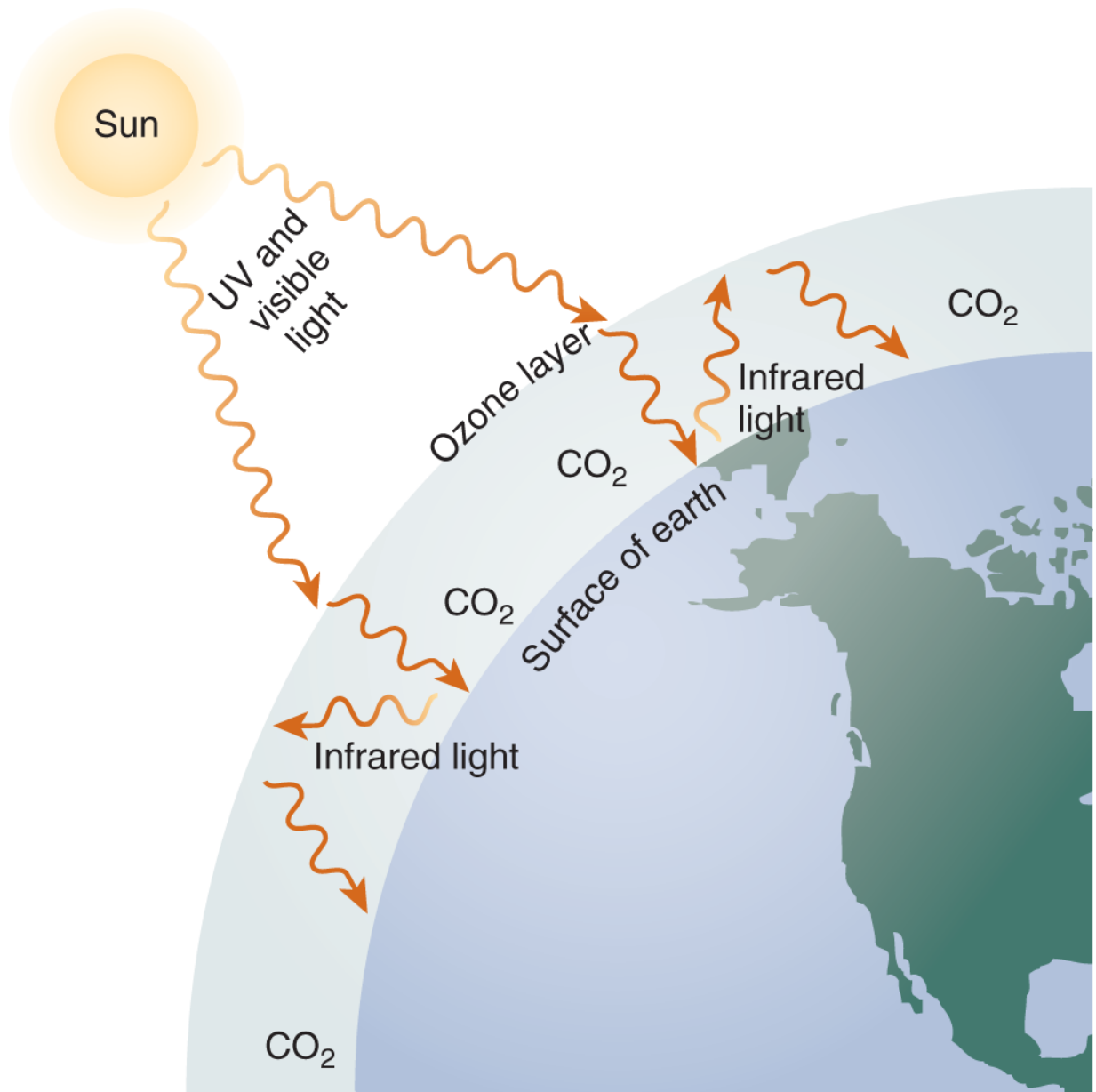


Figure 18.1 Greenhouse Effect. Carbon dioxide (CO₂) in Earth's atmosphere acts like the glass roof in a greenhouse. During the day, the sun's energy passes through Earth's atmosphere and warms the planet's surface. At night, heat energy is radiated back toward the atmosphere, but some of that heat is trapped by atmospheric carbon dioxide and other so-called greenhouse gases. Over time, the trapping of heat increases the temperature of the atmosphere, causing global climate change.

Description

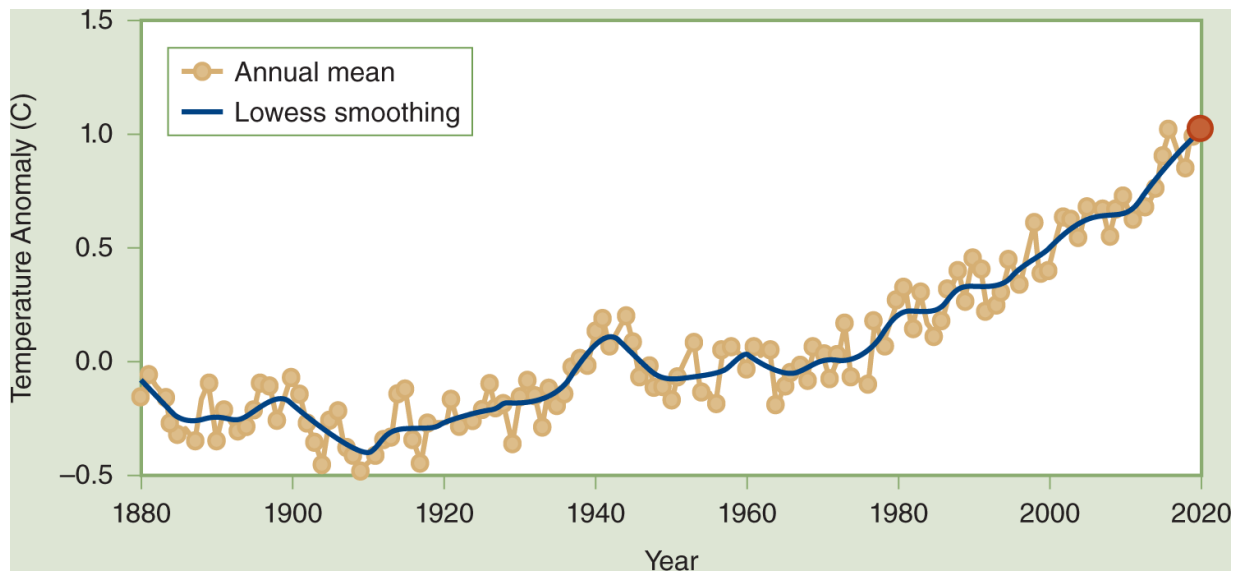


Figure 18.2 Global Temperature Changes (1880–2020). Since record keeping started in the 1880s, average global temperatures have risen 1.02 °C (1.84 °F) because of rising carbon emissions stemming mostly from burning fossil fuels. This graph illustrates the change in global surface temperature relative to 1951–1980 average temperatures. Gray circles indicate temperature for a given year; the black line is the 5-year average temperature. Nineteen of the warmest years have occurred since 2000, with the exception of 1998. The year 2020 tied with 2016 for the warmest year on record since record keeping began in 1880.

Courtesy of NASA. Global Climate Change: Vital Signs of the Planet. Retrieved from <https://climate.nasa.gov/resources/global-warming-vs-climate-change>

Description

Besides carbon dioxide, the following chemicals produced by human activity also contribute to global warming.

- Methane, which we call *natural gas*, is emitted into the atmosphere from leaky wells and pipes as a by-product of oil and gas production and also from agricultural soil and animals. Methane is 85% more potent at warming the atmosphere than carbon dioxide is. Reducing methane emissions, which has

become a U.S. and world priority, could significantly reduce the rate of climate change.

- Nitrous oxides are emitted in the combustion of fossil fuels and outgassing from soil that has been treated with nitrogen fertilizers.
- Fluorinated gases are used as refrigerants in air conditioners and in other industrial applications. These chemicals include chlorofluorocarbons, hydrofluorocarbons, hydrochlorofluorocarbons, perfluorocarbons, and sulfur hexafluoride. They have many times the atmospheric warming potential than carbon dioxide and are undergoing increasing regulation to limit unnecessary emissions.

Although these gases are emitted in small amounts compared to carbon dioxide, they nevertheless are potent warmers of the atmosphere. Reducing emissions can significantly reduce their impact on climate change.

It ain't what we don't know that gives us trouble, it's what we know that ain't so that gives us trouble.

—**Will Rogers**, American actor, author, and comedian

If humans continue to pump carbon dioxide, methane, and other greenhouse gases into the atmosphere even at reduced rates, it is predicted that sometime in this century Earth's temperature will increase 5 to 10 degrees Fahrenheit. Five to 10 degrees may not seem like much, but in climatic terms it is a tremendous change. Some of the predicted effects of global warming include the following:

- A rising sea level from melting ice masses in the Arctic and Antarctic and on mountaintops will be sufficient to flood coastal and low-lying regions all over the world. A 3 °F increase in global temperature will raise the sea level 1 to 3 feet. More than 600 million people live in coastal regions. Many would be forced to relocate, possibly resulting in massive refugee problems. During the past century, sea level rose 4 to 10 centimeters. The Arctic Ocean and tundra are no longer completely covered with ice during winter. Chunks of ice as large as Delaware have broken off the Antarctic ice shelf and have melted in the southern oceans.
- A massive change in Earth's climate will ensue. Some tropical regions will become deserts, and some temperate regions will become more tropical. Rainfall will increase in some parts of the world and decrease in others. Winters may become a bit more temperate with less snow, and summers may be hotter and more humid. Global climate change certainly will affect food production throughout the world in a variety of ways. Already, the natural habitats of many terrestrial and aquatic plants and animals have changed.
- Many diseases, particularly insect-borne diseases, will spread to new regions. Dengue fever, previously unknown in South America, is now prevalent and has spread as far north as Texas. Malaria will spread widely to warmer areas, particularly those subject to large increases in rainfall from tropical storms, cyclones, and hurricanes. Increased weather variability has already contributed to the emergence of both hantavirus pulmonary syndrome and West Nile virus infections. Increased

summer temperatures and humidity will threaten people who cannot take refuge in air-conditioned buildings.

- The number and intensity of violent storms—hurricanes, cyclones, drought, blizzards, and wildfires—will increase globally. Since 1992, record-setting storms have struck countries around the world and produced weather changes, including record rainfall, drought, hurricanes, and tornados in regions of the United States.



Wind-Based Electrical Power

The answer, my friend, is blowin' in the wind.

—**Bob Dylan**, American song writer and performer.

The world uses about 20 trillion kilowatt hours of electricity every year. The bulk of this energy is supplied by coal- and oil-fired generating plants that emit enormous amounts of pollutants into the atmosphere. These plants also are a major contributor to global warming and create health problems for people who must breathe polluted air.

Researchers at Stanford University studied sustained wind speeds at 8,000 locations around the world. They concluded from their study that wind-based power generation is sufficient to meet the entire global demand for electrical power. It was estimated that the United States alone could use wind turbines to produce 14% of the world's total output of electrical energy.

The researchers point out that wind and other renewable energy could totally replace fossil fuels by 2030–2050 if societies were willing to undertake the challenge. Shifting to wind and other renewable energy sources would save about 3 million lives a year and also halt global warming and reduce air and water pollution.

Reducing Your Carbon Footprint

Anxiety over global warming and its consequences for human health has prompted people to search for ways to reduce their individual contributions to CO₂ emissions. Your *carbon footprint* is a measure of

how your lifestyle adds to atmospheric CO₂ and global warming. Some lifestyle changes that help curb further increases in global warming are obvious: Drive less and walk or ride a bicycle whenever possible. If you buy a new car, buy one with high fuel efficiency or an all-electric one. Replace incandescent light bulbs with LED light bulbs and reduce electrical power use wherever possible.

Changing your diet and where you buy food can lessen your carbon footprint. For example, about 15% of all CO₂ emissions from human activities come from the international transport of goods. Thus, buying goods that are produced near where you live can reduce your carbon footprint. Changes in food production and consumption also have an impact. The food and agriculture industries account for about one-third of total greenhouse gases. A major source of emissions is the production of food that is heavily treated with nitrogen-containing fertilizers and on land that is extensively plowed and intensively irrigated and treated with pesticides and herbicides. Methane emissions from the digestive process of cows and sheep and manure management also affect climate change. Meat and dairy production are also responsible for emissions from the growing of grain to feed the cows. A life cycle study found that red meat accounts for about 150% more greenhouse gas emissions than chicken or fish.

Reducing your carbon footprint may help in a small way to solve the problem of global warming. You can calculate your personal climate footprint with the University of California at Berkeley's online calculator: coolclimate.berkeley.edu/calculator

The Ozone Layer

The **ozone layer** consists of ozone molecules (i.e., O₃ or three atoms of oxygen bonded together) that form a layer in the outermost region of Earth's atmosphere. The ozone layer absorbs much of the dangerous ultraviolet (UV) radiation from the sun and protects us from skin cancer and cataracts in the lens of the eye. The ozone in the ozone layer is the same chemical produced in photochemical

smog. However, in the upper reaches of the atmosphere ozone protects life, whereas at ground level it can be destructive.

During the 20th century, a group of chemicals called **chlorofluorocarbons (CFCs)** was widely used as refrigerant and propellant gases in cans. These CFCs escaped into the atmosphere and rose to the ozone layer, where they destroyed ozone molecules. This created a hole in the ozone that appears over Antarctica in the Southern Hemisphere's spring (August to October). The ozone hole reached its largest size in 2020—about three times the size of the United States. The ozone hole occasionally spreads over populated areas of Asia and northern Europe. The intensity of UV radiation in these areas is increasing, exposing people to a higher risk of skin cancer and cataracts.

When the seriousness of the thinning of the ozone layer was realized, 31 industrialized countries agreed in 1987 to phase out the use of CFCs. Even though CFC use has now dropped significantly, the large amounts of these chemicals already in the atmosphere will persist for many decades.

Indoor Air Pollution

In the middle of the last century, in the United States and in other industrialized countries, indoor air pollution was primarily the result of cigarette smoke that accumulated in enclosed spaces. People smoked in bars, restaurants, offices, airplanes, railroad cars—really, everywhere, even in college classrooms—and many indoor environments were hazardous to the health of nonsmokers as well as smokers (see [Table 18.2](#)). In the past several decades, smoking tobacco has been banned from bars, restaurants, offices, airplanes, railroad cars, hotel rooms, taxis, and many public places, including college classrooms. Protecting the quality of indoor air has been a major victory for everyone.

TABLE 18.2

Symptoms of Carbon Monoxide (CO) Poisoning

CO Blood Level (%)	Symptoms
0–2	No symptoms
2–5	No symptoms in most people, but sensitive tests reveal slight impairment of arithmetic and other cognitive abilities. Levels of 2%–5% are found in light or moderate smokers.
5–10	Slight breathlessness on severe exertion. Levels of 5%–10% are found in smokers who inhale one or more packs of cigarettes per day.
10–20	Mild headache, breathlessness on moderate exertion. These levels are sometimes seen in smokers who are exposed to additional CO from other sources.

CO Blood Level (%)	Symptoms
20–30	Throbbing headache, irritability, impaired judgment, defective memory, rapid fatigue
30–40	Severe headache, weakness, nausea, dimness of vision, confusion
40–50	Confusion, hallucinations, ataxia, hyperventilation, and collapse
50–60	Deep coma with possible convulsions
Above 60	Usually results in death.

Elsewhere in the world, especially in low-income countries, indoor air pollution still sickens and kills more than 2 million people every year. At least half of the world's more than 7 billion people live in extreme poverty. To cook food, they build fires that are fueled by organic matter—wood, charcoal, coal, dry vegetation, and dung—in cramped, enclosed living spaces. The smoke from fires used for cooking (and heating) causes extreme indoor air pollution that eventually sickens and kills the inhabitants. Children and women are at highest risk because they spend more time indoors.

The United Nations and member countries are trying to address this global health problem by developing simple stoves and nonpolluting fuels that can replace the toxic cooking fires used around the world. The goal is to develop and distribute 100 million safe cooking stoves to poor people in poor countries all over the world.

Radon

Another form of indoor air pollution is **radon**, an invisible, odorless radioactive gas. Radon is naturally produced in the ground in areas that contain uranium ore. In New Jersey, for example, some homes

built on top of rocks that contain uranium ore have more than 100 times the safe level of radon in the air inside the houses. Homes also may be constructed from bricks or building materials that contain radioactive minerals, one of the decay products of which is radon gas. The radon is slowly released into the house over many years.

Long-term exposure to radon increases the risk of lung cancer. Uranium miners exposed to radon for years have a much higher risk of lung cancer than average. Cigarette smoking seems to act synergistically with radon; smokers who also are exposed to radon get lung cancer at rates much higher than individuals whose exposure is limited solely to cigarette smoke or solely to radon. The Environmental Protection Agency (EPA) estimates that radon exposure in homes is responsible for as many as 30,000 deaths a year from lung cancer. It is possible to test one's home for the presence of radon and to reduce the amount of radon if it is found.

Heavy Metal Pollution

Lead

Lead is a heavy metal that is a serious threat to the health of millions of Americans, especially children. Lead contaminates air, land, water, and houses that still contain lead-based paints. Early symptoms of **plumbism** (lead poisoning) are loss of appetite, weakness, and anemia (**Table 18.3**). Lead poisoning also causes brain damage and is responsible for an enormous number of learning problems among children.

TABLE 18.3 Effects of Lead in People	
Lead Blood Level ($\mu\text{g}/\text{dl}$)	Observable Effects
10	Enzyme inhibition, learning disabilities
10–40	Red blood cells affected

Lead Blood Level (µg/dl)	Observable Effects
40–50	Anemia, infertility (men)
50–60	Central nervous system effects, cognitive disabilities
60–100	Permanent brain damage, death

Since 1970, the Centers for Disease Control and Prevention (CDC) has repeatedly lowered the acceptable level of lead in people's blood. In 1960, the acceptable level was 60 µg/dl; in 1970, the level was lowered to 40, then to 20, and now the acceptable level is zero. No level of lead in the blood is safe. Children's performance on IQ tests is inversely related to the levels of lead in their blood, and any level of lead is likely to have some adverse effect (Lanphear et al., 2005).

About 2% of American children younger than 5 years old have blood lead levels that exceed 5 micrograms per deciliter, the level at which a child should be monitored for health problems. In 1980, almost 90% of American children had blood levels of lead exceeding 10 µg/dl. This reduction in the percentage of children with high blood levels of lead is almost entirely the result of the elimination of leaded gasoline. However, even low levels of lead in the blood may cause health problems later in life. Lead that has been deposited in bone while a person is young can return to the blood as a person ages and bone begins to break down. Small amounts of lead released into the blood of older people may contribute to cardiovascular disease and heart attacks (Chen, 2013).

Poor children are at highest risk for having elevated blood lead levels because they live in old buildings that still contain lead-based paints. The paint flakes off walls, and the lead becomes a component in house dust. Also, the youngest children like to eat paint flakes, which further elevates their blood lead levels.

Unfortunately, neurological damage from lead poisoning cannot be reversed by detoxification. The best way to prevent learning disabilities in children caused by lead pollution is to provide them with a leadless environment.

Lead is important to many industries, particularly the battery industry, so it is still an uphill battle to further reduce the amount of lead released into the environment and to clean up all sources of lead contamination. Despite the progress society has made in reducing lead contamination of the environment, the neurological development of millions of children is still at risk from lead toxicity.

Mercury

In 1953, an epidemic of methylmercury poisoning occurred in several villages around Minamata Bay in Japan. Since that epidemic, mercury poisoning has become known as *Minamata disease*. High levels of mercury in any form, but especially methylmercury, cause a variety of severe neurological symptoms, including blindness, deafness, coma, and death. Symptoms of low levels of mercury poisoning include hair loss and chronic fatigue. In 1970, high levels of methylmercury were found close to the United States in Lake St. Clair in southern Ontario, Canada, where a chemical plant had been discharging wastes. As a result, the U.S. Food and Drug Administration (FDA) began testing lakes and rivers for mercury contamination. Based on these findings, sport-fishing restrictions were implemented by many states because of high levels of methylmercury found in fish taken from contaminated streams and lakes.

Methylmercury is a worldwide environmental pollutant found in freshwater, land, and oceans. Methylmercury contamination of fish in both freshwater and oceans is now common. Because fetal development is especially sensitive to damage by mercury compounds, the EPA and the FDA jointly issued guidelines to limit fish consumption by pregnant women, women who plan to become pregnant, and nursing mothers (**Figure 18.3**).

Best Choices			OR Good Choices		
EAT 2 to 3 SERVINGS A WEEK			EAT 1 SERVING A WEEK		
Anchovy	Herring	Scallop	Bluefish	Monkfish	Tuna, albacore/white tuna, canned and fresh/frozen
Atlantic croaker	Lobster,	Shad	Buffalofish	Rockfish	Tuna, yellowfin
Atlantic mackerel	American and spiny	Shrimp	Carp	Sablefish	Weakfish/seatrout
Black sea bass	Mullet	Skate	Chilean sea bass/Patagonian toothfish	Sheepshead	White croaker/pacific croaker
Butterfish	Oyster	Smelt	Grouper	Snapper	
Catfish	Pacific chub mackerel	Sole	Halibut	Spanish mackerel	
Clam	Perch, freshwater and ocean	Squid	Mahi mahi/dolphinfish	Striped bass (ocean)	
Cod	Pickrel	Tilapia		Tilefish(Atlantic Ocean)	
Crab	Plaice	Trout, freshwater			
Crawfish	Pollock	Tuna, canned light (includes skipjack)			
Flounder	Salmon	Whitefish			
Haddock	Sardine	Whiting			
Hake					

Choices to Avoid		
HIGHEST MERCURY LEVELS		
King mackerel	Shark	Tilefish (Gulf of Mexico)
Marlin	Swordfish	Tuna, bigeye
Orange roughy		

*Some fish caught by family and friends, such as larger carp, catfish, trout and perch, are more likely to have fish advisories due to mercury or other contaminants. State advisories will tell you how often you can safely eat those fish.

Figure 18.3 Advice on Eating Fish. This advice refers to fish and shellfish collectively as “fish.” It supports the recommendations of the *2015-2020 Dietary Guidelines for Americans*.

U.S. Food and Drug Administration, 2019. <https://www.fda.gov/food/consumers/advice-about-eating-fish>.

Description



Dispose of All Mercury Thermometers Safely

Many medicine cabinets in American homes still contain mercury thermometers. If one of these thermometers breaks and the mercury spills, dangerous levels of mercury may be inhaled as the mercury vaporizes, and the contaminated spot will release mercury for months or years.

If you have mercury thermometers, they must be disposed of at a hazardous waste site. Call local government officials to find out how to dispose of hazardous waste in your area. If mercury has spilled in your home, you should contact a hazardous waste expert to arrange a cleanup. The EPA has a hazardous waste cleanup and information website: <https://www.epa.gov/hw/household-hazardous-waste-hhw>

In the United States, coal-fired power plants are responsible for 40% of all mercury pollution. Mercury and other heavy metals are released into the air by the plant's smokestack and are carried around the world by air currents. Rain washes mercury from the air into lakes, rivers, and oceans, where it is transformed by bacteria into hazardous methylmercury. In 2011, the EPA ruled that, as a group, the nation's coal-fired power plants had to reduce their combined amount of mercury pollution by 90% by 2018. Although industry and congressional opponents of the rule have delayed its full implementation, the energy industry is rapidly turning away from coal as a power source because cleaner fuels (natural gas and renewables) are less expensive, making upgrading old coal-fired plants and construction of new ones unwise. Until all coal-fired plants are taken out of commission, people living near them (especially children) are at risk for neurological damage.



Compact Fluorescent Light Bulbs Contain Mercury

Take note: If you're still use compact fluorescent light bulbs (CFLs), dispose of them carefully because they contain mercury and hence are a potential health hazard. Never throw a CFL into the trash. Dispose of them as you would any hazardous waste. If you break a CFL, open windows to help dissipate the mercury vapor. Use gloves and sticky tape to pick up glass fragments and powdery residue. Vacuum the area. Double-bag all the contents and dispose in a hazardous waste pickup if possible. For information on recycling CFLs, go to <https://www.epa.gov/cfl/recycling-and-disposal-cfls>.

Water Pollution

After air, water is the body's most essential requirement. We can survive without air for only a few minutes and without water perhaps for several days. The human body is composed of about 60% water, which is essential to every function carried out by organs in the body.

Agriculture, cities, and industry are enormous consumers of water. For example, producing 1 gallon of gasoline requires 5 gallons of water; brewing a barrel of beer consumes 1,000 gallons; a ton of newspaper takes about 50,000 gallons; a ton of steel requires 25,000 gallons; and irrigating an acre of orange trees requires almost 1 million gallons of water a year. A family of four uses about 400 gallons of water daily.

Water is continuously recycled in the environment by evaporation and rain. However, as more and more water becomes polluted from pesticides, chemicals, oil spills, and sewage, less and less water is suitable for human consumption and agricultural use. Of special concern is the chemical contamination of rivers, lakes, and underground water supplies, which provide most of our water needs. Around the world, safe, sufficient water supplies are stretched to the limit. Worldwide, it is estimated that about 2.4 billion people lack safe, unpolluted drinking water.

Waterborne diseases such as cholera, typhoid fever, and dysentery have been virtually eliminated in North America through sanitation and water-treatment methods. In many communities, the water supplied to homes is purified by sedimentation, filtration, or chlorination. The addition of chlorine to water kills dangerous bacteria, but it may create other health hazards. Interaction of chlorine with other chemicals in the water produces toxic substances such as chloroform and chloramines, which are cancer-causing agents. The widespread use of detergents, herbicides, pesticides, fertilizers, and other chemicals also has contributed to increased water pollution.

Drinking Water

In the early 1970s, the Environmental Protection Agency found that the water supplies of many towns and cities were dangerously contaminated with pathogenic organisms and toxic chemicals. As a result, Congress passed the Safe Drinking Water Act of 1974, which covers 58,000 community water supply systems and another 160,000 private systems. The act requires that these systems meet federal drinking water safety standards, but it is one thing to pass such a law and another thing to enforce it.

In 1996, Congress renewed the Safe Drinking Water Act of 1974. Under the new act, consumers must be notified whenever contaminants are found in drinking water and not merely when the water does not meet federal standards for contamination and safety. Community water systems in the United States must be tested for 90 contaminants. Each year, about 7% of community water systems report exceeding federal safety levels for at least one contaminant, which may be why so many people now buy and drink bottled water. You can find your community's water system report by asking your water supplier directly or by searching the Environmental Protection Agency website: epa.gov/ccr.

If you can find a path with no obstacles, it probably doesn't lead anywhere.

—Frank A. Clark, American attorney and politician

The most dangerous and ubiquitous chemical found in drinking water is arsenic. This chemical, which occurs naturally in soils and water supplies around the world, is a well-known poison. In low doses, arsenic increases the risk of cancer; at higher doses such as those occurring in well water, arsenic causes skin eruptions, vomiting, diarrhea, pain, and death. Globally, at least 50 million people are at risk of arsenic poisoning from drinking arsenic-contaminated water.

Americans generally take for granted their (seemingly) endless supply of safe, clean water for daily needs ([Table 18.4](#)). Most of the people in the world, particularly in developing countries, are not so fortunate. More than 2 billion people in the world do not have access to safe, clean water. Many of those who do must carry their water in buckets from sources a long way from where they live. In the United States, water is becoming increasingly scarce. A recent study estimated the likelihood of water shortages over the remainder of the 21st century in 204 watersheds covering the contiguous United State (Brown et al., 2019). The researchers predict that future improvements in water use efficiency are likely to be insufficient to avoid shortages. Because of climate change induced drought particularly, in the American West and Southwest, large additions to reservoir storage hold little promise for adaptation.

TABLE 18.4 Water Use	
Average Water Use per Person in the United States	
Toilet	12 gallons/day
Shower	25 gallons/day
Bath	36 gallons/day
Personal faucet washing	3 gallons/day
Leaks	10 gallons/day
Garbage disposal	5 gallons/day
Washing machine	25 gallons/load
Dishwasher	10 gallons per load
Ways to Conserve Water	

Average Water Use per Person in the United States

Check and fix leaks in faucets and toilets.

Install low-flush (1.6 gallon) toilets.

Install low-flow shower heads (2.5 gallons/minute).

Do not overwater lawn and gardens.

Do not leave hose running when washing car.



Bottled Water Battles

In 2019, Americans consumed about 14.5 billion gallons of water in plastic bottles. The water bottled by the two largest distributors—Pepsi (Aquafina) and Coca-Cola (Dasani)—is usually reprocessed tap water, a bit of a downer for people who think they're getting clean, natural spring water. About 35 billion plastic water bottles (1 billion pounds of plastic) are discarded each year. Although some bottles are recycled, the vast majority clutter streets and lots, pollute the oceans and waterways, or wind up in landfills. Also, bottled water is an energy hog. It takes an about 1.5 million barrels of oil to manufacture all those plastic water bottles, and then there is the energy used to transport the bottles to markets and to clean up after they're discarded.

Earth would be grateful if humans didn't use so many plastic water bottles. Do Mother Nature a favor and fill a reusable with tap water and carry it with you. Enjoy.

The average American uses 100 or more gallons of water a day, much more than the 10 to 15 gallons a day most people need for drinking, cooking, and washing. In many American cities as much as one-third of all the water is lost before it reaches consumers because of leaky or broken underground pipes. One of the predicted effects of climate change is difficulty obtaining water for drinking, agriculture, manufacturing, and other needs.

Land Pollution

Until relatively recently, little attention was paid to the disposal of garbage and solid wastes in landfills around the country. Now, however, communities are beginning to run out of space to dump what they want to get rid of. Each year in the United States, we junk about 8 million cars and trucks; 100 billion cans, bottles, and jars; and more than 200 million tons of garbage. The average American generates more than twice as much garbage as citizens of other industrialized countries.

Many old, abandoned solid-waste disposal sites are dangerous to health because they contain hazardous materials that may be corrosive, flammable, or contain toxic chemicals (Table 18.5). In 1980, Congress passed the Superfund Act, which provides for the cleanup of the most dangerous waste sites. Forty years later, 424 Superfund sites have been cleaned up—but 1,344 remain. More than 1,000 toxic waste sites await attention. An estimated 11 million Americans live within a mile of one of these Superfund sites, and their health is at some risk from exposure to toxic substances. You can find out where Superfund sites are located and whether you live near one of the listed sites. Go to <http://www.epa.gov/superfund/search-superfund-sites-where-you-live> to find out if you are living close to a Superfund site.

TABLE 18.5

Hazardous Wastes That Escape into the Environment Cause Many Health Problems

Millions of tons of these substances are discarded every year in the United States.		
Substance	Source	Health Effects
Mercury	Sludge from chloralkaline plants; electrical	Tremors, intellectual disabilities, loss of teeth, kidney damage, neurological damage

	equipment, fluorescent lights	
Arsenic	Arsenic trioxide from coal combustion and from metal smelters	Diarrhea, vomiting, paralysis, skin cancers
Cadmium	Waste from electroplating industry; paint containers, nickel–cadmium batteries	Lung diseases
Cyanide	Electroplating industry waste	Poisoning; interferes with cellular energy metabolism
Pesticides	Solid wastes and wastes in solutions	Multiple effects, including rashes, respiratory and gastrointestinal symptoms, neurological disorders, hemorrhages



Good Riddance to the Plastic Bag

The plastic bag is arguably the most environmentally destructive item ever invented. A large percentage of the trillion or so plastic bags produced every year end up as solid waste and are buried, burned, or neglectfully discarded, clogging sewers and killing fish, birds, and animals all kinds. Discarded plastic bags not only are an unsightly nuisance but also collect water and provide a breeding ground for disease-transmitting mosquitoes.

Perhaps civilized societies have finally had it with plastic bags. In 2007, San Francisco became the first U.S. locale to ban the use of polyethylene (plastic) shopping bags. Since then, hundreds of municipalities in the world have banned or placed fees on the use of plastic bags. Get with the trend: Take planet-saving bags with you when you shop.



Reduce, reuse, recycle.

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Every year millions of cars, tires, appliances, computers, TVs, paints and solvents, construction materials, and other objects, large and small, wind up in landfills or toxic waste-disposal sites. Many items can be recycled with a little effort. Check earth911.com to find a recycle or disposal facility near you.

Pesticides

Soil, water, foods, and people have become increasingly contaminated with chemicals used to control weeds, insects, and plant diseases. Any chemical capable of killing an unwanted plant or animal is a **pesticide**. *Insecticides* kill insects, *fungicides* kill molds and fungi, *herbicides* kill weeds, and *rodenticides* kill rats and mice. Pesticides are important to the agriculture industry, which has claimed over the years that the abundance and quality of food grown in the United States depend on the use of chemicals to destroy crop pests. That pesticides contribute to agricultural productivity is contested by people who practice organic farming. The Environmental Protection Agency is tasked with balancing the legitimate use of chemicals by agriculture and other industries while safeguarding public and environmental health.

Of particular concern is the agricultural pesticide *atrazine* (National Pesticide Information Center, 2000). Each year about 76 million pounds of atrazine are used by farmers to control weeds. Most of the pesticide is used on corn, cotton, sugar cane, and sorghum crops. It also is used on some golf courses. Studies show that the pesticide is carried by runoff into lakes and streams and that fish and amphibians in atrazine-contaminated waters exhibit sexual deformities, sterility, and abnormal development of sexual organs. Because of its widespread use, atrazine is now found in significant amounts in drinking water around the country.

Because of increasing concerns about the possible adverse effects of atrazine on human health and the environment, the pesticide has been banned in the European Union, though it is still widely used around the world.

Most of the pesticides that accumulate in the bodies of young children come from the foods they eat. Switching a child's diet to organic foods lowers the concentration of agricultural pesticides in their bodies within a few days.



Precautions for Pesticide Use

- Before you buy a pesticide product, read the instructions for use and any health and safety warnings. When mixing, do not increase the concentration of the pesticide above the label-recommended amount. Do not purchase the product if you can't use the pesticide properly (you may not have the right equipment). If you don't understand or feel completely comfortable with the health and safety information provided, get more information from the distributor or manufacturer before you buy the product. Also, consider whether you have safe and adequate storage for the pesticide.
- Use the least toxic pesticide available for your pest-control problem. Try to strike a balance between effective pest control and the safety of people, pets, and other nontarget organisms. Minimize skin and respiratory contact with pesticides. Wear rubber gloves. When you select gloves, consider both the solvent used in the pesticide formulation and the possibility that the pesticide itself can penetrate skin. You may want to use a respirator to guard against inhaling pesticide spray or dust.
- Use pesticides only for the uses for which they are intended. For instance, some wood preservatives are meant for outside use only, so don't use them inside the house!
- Don't leave seemingly empty pesticide containers where children can get them. Children have been poisoned by drinking from "empty" containers that actually contained leftover pesticide.
- Never smoke, eat, or drink while using pesticides.

Generally, the health effects of pesticides on people and other animals are subtle. For the most part, pesticides do not cause sudden, severe sickness or death unless the amount of exposure is extremely high. The amount of pesticide capable of causing death varies widely, depending on the specific chemical as well as on individual susceptibility.

As a society, we are not ready to abandon the use of pesticides. However, as individuals we should restrict our use of pesticides as much as possible to protect ourselves and the environment. To achieve this goal, many people now grow their own vegetables without the use of pesticides. Others shop at stores that sell organic

fruits and vegetables grown without the use of pesticides and herbicides.

Endocrine Disruptors

Endocrine disruptors are chemical substances, usually pesticides, in the environment that enter the body and interfere with the action of one or more hormones. Some endocrine disruptors mimic the effects of a hormone, causing overstimulation of a normally regulated biological process. Other endocrine disruptors block the actions of normal hormones, thereby lessening or completely inhibiting a biological process. Because hormones are present in the body in minute amounts, only a small amount of an endocrine disruptor can affect a bodily process that depends on hormone actions. Environmental endocrine disruptors include pesticides such as DDT, vinclozolin, endosulfan, toxaphene, dieldrin, and DBCP, and industrial chemicals and by-products such as polychlorinated biphenyls, dioxins, and phenols, some of which are derived from soaps and detergents. Other potential endocrine disruptors include heavy metals, plastics, cosmetics, textiles, paints, lubricants, and sewage treatment effluent, which may contain a variety of natural and synthetic endocrine disruptors, including natural hormones from animal and human waste.



Large amounts of pesticides are routinely sprayed on major food crops.

© Pixtal/Age fotostock

The EPA carries out an Endocrine Disruptor Screening Program (<http://www.epa.gov/endocrine-disruption>) that focuses on possible effects of environmental chemicals on estrogen, androgen, and thyroid hormones. Estrogens, produced primarily by the ovaries and in small amounts by the adrenal glands, are responsible for female sexual development and sexual and reproductive function. Androgens, including testosterone, are responsible for male sexual development and sexual and reproductive function. Thyroid hormones control many biological processes such as growth, reproduction, development, and metabolism.

Hundreds of studies have shown high levels of endocrine-disrupting chemicals in the tissues of animals, including large mammals, birds, and fish. For example, the pesticide dicofol, chemically similar to DDT, is present in a lake in Florida as a result of dumping by a chemical company that used to operate on its shore.

Dicofol mimics the action of estrogen and causes abnormalities in the reproduction and sexual development of alligators.



Plastic Microbeads and Microfibers Pollute

Oceans and Seas

Earth's seas and oceans are increasingly polluted with oil, chemicals, fertilizer runoff, fishing lines, and garbage. But among the most hazardous pollutants are microscopic beads and fibers formed by the breakdown of millions of tons of discarded plastic objects of all kinds. These tiny particles are ingested by sea creatures and birds that mistake them as food. Tragically, adult birds pick up these bits of plastic and feed them to baby birds that subsequently die from lack of nutrients. These tiny plastic beads never degrade entirely.

Plastic microfibers from discarded fleece jackets, athletic clothing, yoga pants, and other apparel used to increase softness and sweat absorption are also a threat to sea creatures. With every wash, microfibers are released from the cloth and go down the drain and eventually into a river or the ocean. Fish and other sea life ingest the microfibers as they feed. Tests of water from the Great Lakes and New York Harbor show high concentrations of plastic. Testing of waters where oysters grow shows that they ingest microfibers. One possible solution to the plastic microfiber problem may be to require all washing machines to have filters engineered to capture the fibers on a screen before they can be released into the environment.

Mounting evidence suggests that endocrine disruption occurs in humans. For example, chronic exposure to the organophosphate pesticide endosulfan delays the onset of puberty in adolescent boys. This pesticide is widely used on squash, melons, strawberries, and other crops around the world. In the United States, more than a million pounds of endosulfan are used every year. Because it can pose unacceptable health risks to farmworkers and wildlife and can persist in the environment, EPA is taking action to end the use of the pesticide endosulfan.

Before manufacturers can sell pesticides in the United States, the EPA must evaluate the pesticides thoroughly to ensure that they meet federal safety standards to protect human health and the environment. The EPA grants a *registration* or license that permits a

pesticide's distribution, sale, and use only after the company meets the scientific and regulatory requirements. In evaluating a pesticide registration application, the EPA assesses a wide variety of potential human health and environmental effects associated with use of the product. Potential registrants must generate scientific data necessary to address concerns pertaining to the identity, composition, potential adverse effects, and environmental fate of each pesticide.

Toxic Plastics

Plastics are almost entirely derived from petroleum. Some plastics are made of one or several types of chemicals linked together in long arrays. In some circumstances, the end product plastic is not harmful to health, but it may contain individual components that are. Thus, people involved in the manufacture of the plastic may be exposed to harmful effects of one or more of the component chemicals with which they work. Also, the plastic product may degrade and release its toxic chemical components into the environment. This is called *leaching*. Leaching can occur when a plastic is heated or exposed to microwave radiation or comes into contact with liquids, fats, oils, and detergents. Types of plastics shown to leach toxic chemicals are polycarbonate, polyvinylchloride, and styrene. Other plastics may be harmful, but studies of their safety have yet to be carried out.

Phthalates are used in the manufacture of plastic flooring, medical devices, cosmetics, and coatings on drugs. Phthalates are everywhere in the environment, and nearly 100% of humans have significant levels of phthalate in their bodies. Exposure to phthalates, particularly in fetuses and children, has been linked to a variety of developmental abnormalities (Mankidy et al., 2013). For example, phthalate exposure appears to increase the risk of allergy and asthma, abnormal breast development in pubertal boys, and early onset of puberty in girls. Phthalates in the body have an adverse effect on children's brain and sexual development. Phthalates impair sperm quality, reduce the level of reproductive hormones, affect thyroid functions, and alter the development of reproductive organs in boys.

Bisphenol-A (BPA) is a chemical used in the manufacture of polycarbonate plastic, a clear, hard plastic identified by the number 7 imprinted somewhere on the product. BPA is also found in the epoxy resins used as lacquers to coat metal products such as food cans, bottle tops, and water-supply pipes. BPA has been linked to

miscarriages, birth defects, and abnormal brain development in fetuses.

BPA was first synthesized in the 1930s in an effort to develop a synthetic estrogen but was abandoned in favor of diethylstilbestrol, which proved to be a more effective estrogen. Subsequently, chemists discovered that BPA could be used to make polycarbonate plastic. Today, polycarbonate plastics are used in canned goods, water bottles, baby bottles, microwave cookware, and many other food-related products. As polycarbonate plastics age or are heated or exposed to strong detergents, BPA leaches out. Studies show that 92% of Americans have significant amounts of BPA in their bodies. BPA also leaches out of the resins used to coat food cans.

Pregnant women and nursing mothers should avoid products made of polycarbonate plastic as much as possible. Do not use polycarbonate plastic water bottles or, if you do, do not wash them in hot water with detergent. Do not use baby bottles or baby gadgets that are made of polycarbonate plastic. Do not heat food in polycarbonate plastic containers. In general, try to avoid any food or beverage that is packaged in polycarbonate plastic.

Many studies suggest that BPA is a health hazard (Konieczna et al., 2015). In 2012, the FDA banned the sale of baby bottles and children's drinking cups made with BPA. The European Union and Canada have banned BPA use in baby bottles. However, the FDA has been reluctant to ban the use of polycarbonate plastics for food and beverage containers, claiming that studies do not suggest that the amounts of BPA found in all manner of packaging and in nearly everyone's body are harmful.

Monitoring Environmental Chemicals

To monitor the effects of potentially harmful environmental chemical pollution on human health, the CDC has been measuring the chemical load in a cross section of Americans every 2 years since the late 1990s. In its *National Report on Human Exposure to Environmental Chemicals*, the CDC measured levels of 148

chemicals in blood and urine samples taken from people of all ages (U.S. Centers for Disease Control and Prevention, 2021).

The measurement of environmental chemicals that are detectable in the body is called **biomonitoring**. Chemicals enter the body from air, water, food, dust, soil, or consumer products. Although the sensitivity of chemical tests has improved in recent years, the health effects of many environmental chemicals that accumulate in the body are unknown, and more research must be done.

Electromagnetic and Microwave Radiation

Electric power lines, appliances, motors, TV sets, microwave ovens, power tools, computers, and mobile phones all emit extremely low-frequency **electromagnetic fields (EMFs)**. Except for Earth's electromagnetic field, all EMFs come from electricity that is generated by electrical devices of all kinds. Only in the past few generations have people been exposed to these magnetic fields. Until recently, EMFs were thought to be too weak to affect living organisms, so their possible impact on health was ignored. Now, however, because the use of consumer products that emit EMFs has increased in the past two decades and advanced methods to detect genetic damage are available, scientists are looking more closely at possible deleterious effects of EMFs on health (Karimi et al., 2020). The results of studies of an association between EMF exposure and cancer risk are suggestive but inconclusive (U.S. National Cancer Institute, 2019).

All of us are exposed to EMFs every day. An electric shaver or hair dryer puts out a strong EMF, although users are exposed for only a few minutes a day. If a person lives near a high-voltage transmission line, exposure to EMFs may be considerable, depending on the distance between the house and the wires. And the exposure goes on day and night. At best, calculating EMF exposure yields crude approximations, one reason why the evidence regarding EMFs and harmful health effects is conflicting.



Ways to Reduce Your Exposure to EMFs

- Don't use an electric blanket or waterbed heater unless it is a newer model with reduced EMFs.

- Use battery-operated shavers and hair dryers. Battery-operated appliances and toys do not put out EMFs.
- Don't sit too close to computers, TVs, fans, or light fixtures.
- If your work requires long exposure to EMFs, look for ways to reduce it. Do not sit too close to computer screens for long periods.
- If you rent or buy a house, choose one that is not near a high-voltage line or distribution transformer.

Digital cellular phones emit pulses of microwave radiation. Millions of Americans use cell phones, often for several hours a day. Some cancer researchers believe that many hours of cell phone use carries a risk of getting a brain tumor (Choi et al., 2020). Another issue is the health consequences of working in modern offices that are filled with microwave radiation from a variety of electronic devices. People who use cell phones extensively should use a headset to keep the phone away from the head.

Noise Pollution

Everyone is sensitive to noise, and excessive noise produces stress and can cause health problems such as hearing loss. Noise interferes with sleep, and over periods of time it can cause fatigue, irritability, tension, and anxiety.

Sound activates the nervous system, thereby affecting functions of the endocrine, cardiovascular, and reproductive systems. Noise is a *stressor* and can increase blood pressure, alter hormone levels, constrict blood vessels, and cause intense pain at high levels.

Sound levels are measured in **decibels (dB)**. The danger zone for hearing loss begins at about 85 dB, a level present on school buses crowded with kids or driving in freeway traffic with the window open (**Table 18.6**). Many daily activities expose us to sound levels that can permanently damage hearing. Millions of people in the United States are exposed to dangerous levels of sound every day that can cause hearing loss.

TABLE 18.6 Loud Noise Encountered Daily	
A noise level above 85 dB can damage hearing and cause hearing loss over time.	
Source of Noise	Sound Level (dB)
Firearms	140 to 170
Jet engines	140
Rock concerts	90 to 130
Amplified car stereos	140 (at full volume)
Portable stereos (e.g., iPods)	115 (at full volume)
Power mowers	105

Jackhammers	100
Subway trains	100
Video arcades	100
Freeway driving in a convertible	95
Power saws	95
Electric razors	85
Crowded school buses	85
School recesses or assemblies	85
Hair dryer	60 to 90
Normal conversation	40
Quiet room	10

Rock musicians and people who listen to loud rock music are particularly at risk for hearing loss. Members of many famous rock bands suffer from **tinnitus**, a persistent ringing in the ears, or they have lost a significant amount of their hearing. Children are especially prone to turning up the volume and to listening to music with earphones at dangerously high sound levels. A nationwide study of hearing loss among American children and adolescents found that almost 15% had some degree of hearing loss at both the high and low end of audible frequencies (Su & Chan, 2017). Some had hearing loss in only one ear; others had hearing loss in both ears.

Even a brief exposure to sustained loud noise can damage the sensitive structures of the inner ear. Hearing loss is caused not only by listening to loud music but also by noise in urban environments. The noise levels at sporting events, rallies, and other places where large numbers of people congregate can also contribute to hearing

loss. Hearing loss is a major problem for the elderly. Protect your hearing while you are young; keep the volume down.





Keep the volume low to avoid hearing loss.

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Many people live and work amid the din of urban life and have forgotten the rest and peacefulness that come with silence. If you have the good fortune to spend time at isolated spots in remote woods or mountains, you become aware of the beneficial effects of quiet. The human need for stillness was expressed eloquently in 1854 by Chief Seattle, after whom the modern city in Washington state is named:

There is no quiet place in the White man's cities. No place to hear the unfurling of leaves in spring or the rustle of insects' wings. But perhaps it is because I am a savage and do not understand. The clatter only seems to insult the ears. And what is there to life if a man cannot hear the lonely cry of the whippoorwill or the arguments of the frogs around a pond at night?

How Human Population Growth Affects Us

In 1960, the world's population was about 3 billion people. By 2013, the world's population more than doubled to 7.2 billion people. By 2050, the world's population is expected to reach 9.6 billion people; and by 2100, 11.3 billion (**Figure 18.4**). The fastest population growth today is occurring in Africa, which is expected to have 6 billion people by 2050, more than half the entire world population.

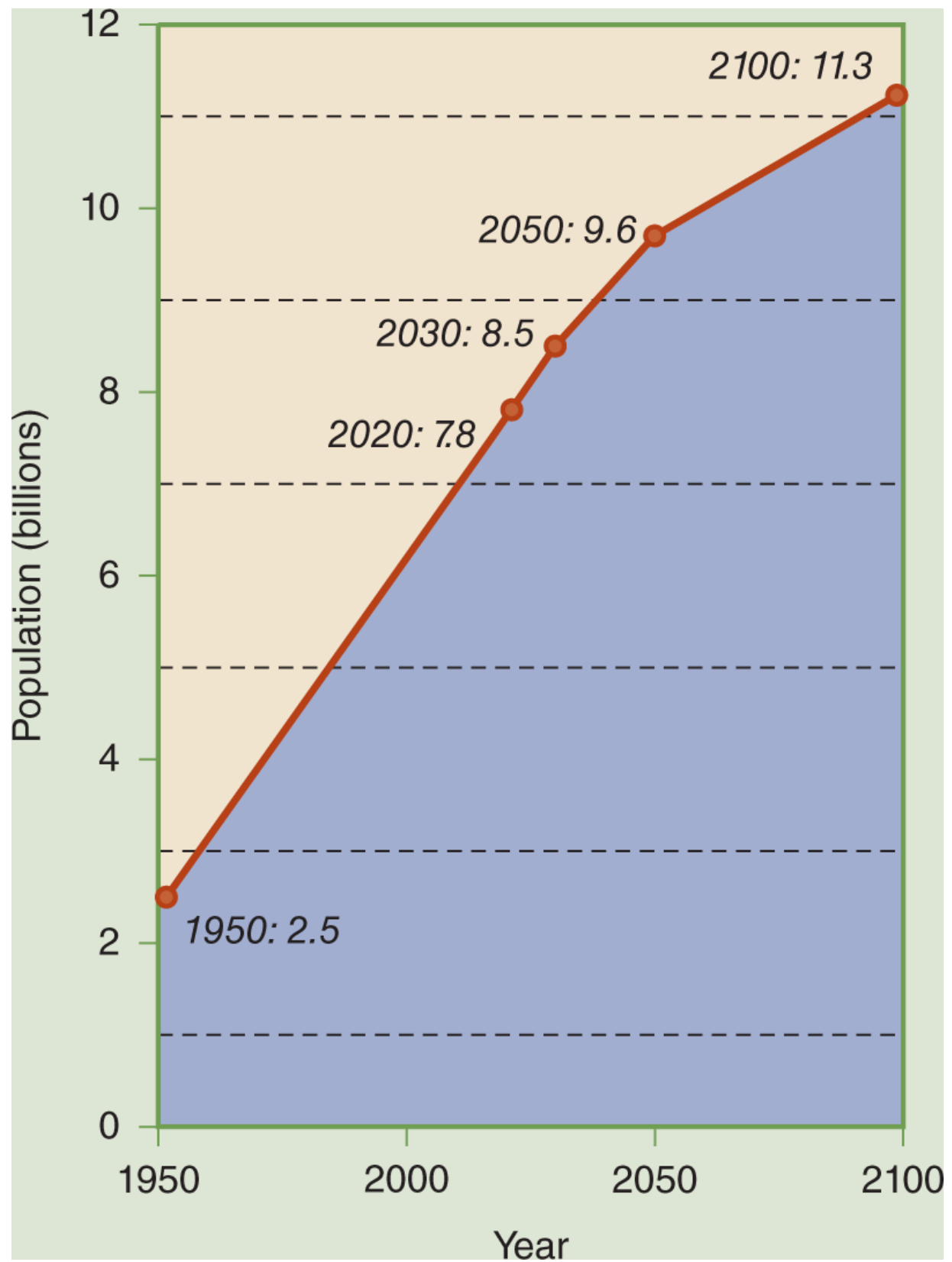


Figure 18.4 World Population from 1950 to 2050 (estimate).

Data from U.S. Census Bureau. (2011). World Population 1950–2050.
<http://www.census.gov/population/international/data/idb/worldpopgraph.php>

Young people ages 10 to 19 currently make up the largest age group in the world, accounting for about 20% of the world's total population. Virtually all of the population increase in the next 40 years is expected to take place in underdeveloped nations, especially in the world's poorest countries (**Table 18.7**). In contrast, the developed, industrialized nations are expected to be near zero population growth, except for the United States.

TABLE 18.7 Countries Projected to Have the Largest Populations in 2050

By 2050, the world's population is predicted to increase to about 10 billion people. Most of the population increase will occur in the poorest and least developed countries in Africa and Southeast Asia. The population of the United States is expected to increase by about 50%, whereas the populations of most European countries will decline. The estimates for 2050 do not take into account food scarcity, weather extremes, and social unrest and war caused by climate change.

Country	Population	
	2021	2050
India	1.3 billion	1.6 billion
China	1.4 billion	1.3 billion
United States	330 million	389 million
Nigeria	219 million	410 million
Indonesia	275 million	321 million
Pakistan	238 million	307 million
Bangladesh	164 million	201 million

Brazil	203 million	236 million
Dem. Rep. of Congo	110 million	196 million

Data from U.S. Census Bureau. (2014). International data base country rankings.
<http://www.census.gov/population/international/data/idb/rank.php>

Of the nearly 8 billion people living today, an estimated 1 billion have no access to clean water, 2 billion have inadequate sanitation, and 1.5 billion breathe polluted, unhealthy air. Human activities are resulting in the extinction of almost 10,000 plants and animal species a year. A few hundred years ago, the rate of extinction was about 10 species per year.

Deforestation, loss of native species of plants and animals, depletion of natural resources, and air, water, and land pollution are all related to too many people needing too many scarce resources. The demand for modern lifestyles and products adds to the destruction and pollution of the environment.

The actions, needs, and goals of people are at the root of all environmental problems and the ongoing destruction of nature. As the economies of nations become stronger and the aspirations of people around the globe increase, so does the rate of environmental destruction. Political and economic solutions to the population problem are acknowledged, but many nations are unable or unwilling to undertake the measures that might curb population growth. Some countries have family-planning programs, but the success of these programs depends on educating people and in raising their standard of living so that they understand that large families are not in their best interest. Most of the world's population is opposed to any form of birth control, so the world's population is expected to continue to increase for at least the next 50 years. To most researchers who study human population dynamics, 11 billion people is certain to strain Earth's carrying capacity, with the possible consequences of famine, pandemic disease, wars, catastrophic climate changes, and breakdowns in human societies.



Harmony and Peace

Many Native American cultures and tribes incorporate the idea of harmonious interactions with nature, animals, and other peoples and their religions. The following is by Black Elk (186–1950), religious leader and educator of the Oglala Lakota people.

The first peace,
which is the most important,
is that which comes from
within the souls of men when they
realize their relationship,
their oneness, with the universe
and all its powers,
and when they realize that
at the center of the universe dwells
Wakan-Tanka, and that
this center is really everywhere,
it is within each of us.
This is the real peace, and the others are
but reflections of this.
The second peace is that which is
made between two individuals,
and the third is that
which is made between two nations.
But above all you should
understand that there can never be peace
between nations until there is
first known that true peace which . . .
is within the souls of men.

The Sacred Pipe, Black Elk's Account of the Seven Rites of the Oglala Sioux, by Joseph Epes Brown. Copyright © 1953, 1989 by the University of Oklahoma Press.

In wilderness is the preservation of the world.

—Henry David Thoreau

The dinosaurs survived for about 150 million years and disappeared about 65 million years ago, presumably as a result of Earth being hit by a giant meteor that changed the climate drastically. According to anthropologists, the modern human species has been around for only about 3.5 million years. At the rate we are destroying habitat, using up Earth's resources, and polluting the environment, we may be hastening our own disappearance.

What we call the beginning is often the end And to make an end is to make a beginning. The end is where we start from.

—T. S. Eliot, "Four Quartets"

Critical Thinking About Health

1. Check around your house or apartment and make a list of all pesticides or herbicides that are stored anywhere. Decide which ones you really need to keep and which ones can be discarded. (Check with your local waste-management authorities for proper disposal of pesticides and herbicides.) Make a list of how and when you use pesticides and what precautions you take when you use them. After doing this, write a report on how you can reduce your use and exposure to pesticides and herbicides.
2. If you, like many Americans, are committed to halting global warming by reducing your contributions to increasing levels of atmospheric carbon dioxide, consider these suggestions:
 - Reduce your electricity use by 30%. What appliances use the most electrical energy and what changes can you make to reduce their use?
 - Reduce the use of your automobile by 30% or more. What changes in your lifestyle can you make that will reduce your dependence on car transportation?
 - Find out what industries release the most CO₂ in manufacturing their products. Are these products essential to your life, or would you be able to live without some of them?
3. The major global threats to the environment are (a) nuclear, chemical, and biological warfare; (b) pollution; (c) global warming; (d) land and ocean degradation; and (e) extinction of species of plants and animals. Indicate which of these global environmental problems is of the most concern to you personally. What can you personally do about the problem? What do you think governments should do about the problem? Discuss any effects that you think this problem will have on your life now and in the future.
4. If you had the option of living anywhere in the world, where would you choose to live? Is your choice largely determined by job

opportunities, environmental concerns, access to a favorite sport (e.g., surfing), or some other variable? Discuss your choice in detail, and explain the things that are most important to you in making your selection. Do you think your choice will be the same 10 years from now? Why might it change?

CHAPTER SUMMARY AND HIGHLIGHTS

CHAPTER SUMMARY

Our planet was formed along with the rest of the solar system about 5 billion years ago. The first signs of life appeared perhaps 3 to 4 billion years ago. Over time, species of all kinds arose and became extinct as conditions on Earth changed. Just a few million years ago, the first human-like species appeared. Now there are about 7.2 billion of us living on Earth. To be in good health, a person needs unpolluted air, water, and food, as well as adequate shelter and a nutritious diet. Unfortunately, only a minority of people live in such conditions. Many of the world's peoples live in dire poverty, suffer many diseases, and die prematurely. Despite problems of disease, starvation, war, and genocide, the human population is predicted to reach 9.6 billion by 2050. Humans now occupy every ecological niche on the planet and have produced so much air pollutants that we have already altered Earth's climate with unpredictable future consequences for our survival. Like it or not, it is going to get hotter and hotter. Unpolluted air, water, and food will become scarce. With an additional 2 billion people on Earth by 2050, what will life be like?

You probably will be someone who will live to know the answer to this question, so you have a vital interest in helping Earth survive and possibly recover from ongoing pollution and temperature rise. Think more about where to live than where to work when you finish college. Is the air relatively unpolluted most of the time? What is the source of the water where you plan to live? Are there farmers' markets or other nearby sources of fresh fruits and vegetables? These are questions that previous generations would have considered foolish. But Earth evolves. The dinosaurs lasted about 165 million years on Earth before becoming extinct in a matter of a few centuries. We have been around for a mere 5 million years or fewer. Extinction can happen to us in a brief time as well.

HIGHLIGHTS

- To maintain good health, people require adequate unpolluted air, water, food, and shelter.
- The air we breathe is often polluted with ozone, carbon monoxide, hydrocarbons, nitrogen and sulfur oxides, lead, cigarette smoke, and other contaminants.
- Global warming is expected to cause serious environmental disruptions in this century.
- The greenhouse effect and the ozone hole are examples of global environmental problems caused by human activities.
- Pollution of air, land, and water from heavy metals such as lead is particularly hazardous to health. Children with even small amounts of lead or mercury in their bodies may suffer from learning deficits and growth retardation.
- Drinking water may be contaminated with chemicals or microorganisms that can cause disease.
- Pesticides, some of which are endocrine disruptors, can harm health, especially reproduction.
- Noise pollution can cause a wide range of health problems, including stress, tinnitus, and hearing loss.
- World population is expected to increase by 3 billion people in the next 50 years, severely taxing an already depleted environment and creating more health and environmental problems.

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<https://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/electromagnetic-fields-fact-sheet>

KEY TERMS

environment:

all external physical factors that affect us

smog:

air polluted by chemicals, smoke, particles, and dust

photochemical smog:

air pollution from the action of sunlight on emissions from motor vehicles and industrial sources

particulate matter (PM):

consists of microscopic particles that released into the air principally from the burning of diesel fuel, coal, and other fossil fuels

greenhouse effect:

the ability of atmospheric carbon dioxide to reflect heat radiated from Earth back to Earth and to thereby raise Earth's temperature globally

ozone layer:

a layer of ozone molecules located in the stratosphere in a diffuse band extending from 10 to 30 miles above Earth's surface

chlorofluorocarbons (CFCs):

chemicals formerly used as coolants that are released into the atmosphere and that are responsible for destroying stratospheric ozone

radon:

a radioactive gas found in some homes that can increase the risk of cancer

plumbism:

disease caused by lead poisoning

pesticide:

a chemical that kills unwanted plants and animals

endocrine disruptors:

are natural or industrial chemicals that mimic or interfere with the body's intrinsic endocrine (hormone) system

phthalates:

chemicals used in the manufacture of various plastics; may cause abnormal genital development in males and premature breast development in girls

bisphenol-A (BPA):

chemical used to manufacture polycarbonate plastics; may cause abnormal brain development in fetuses and birth defects

biomonitoring:

measurement of environmental chemicals present in the body that may harm health

electromagnetic fields (EMFs):

a form of radiation produced by electrical power lines and appliances that may increase the risk of cancers

decibel (dB):

a measure of noise level

tinnitus:

persistent ringing in the ears, often caused by repeated or sudden exposure to loud noises



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Glossary

A

abortion:

the expulsion or extraction of the products of conception from the uterus before the embryo or fetus is capable of independent life; abortions may be spontaneous or induced

accident mitigation:

methods to reduce damage caused by unplanned events

accident prevention:

ways to eliminate the occurrence of unintended injuries

accident:

sequence of events that produces unintended injury, death, or property damage; refers to the event, not the result of the event

acquaintance rape:

(also known as “date rape”) sexual assault occurring when the victim and the rapist are known to each other and may have previously interacted in some socially appropriate manner

acquired immune deficiency syndrome (AIDS):

a syndrome of more than two dozen diseases caused by HIV

acupuncture:

an ancient Chinese alternative medicine that uses thin needles inserted into specific points on the body to produce healing energy

adult attention deficit hyperactivity disorder (ADHD):

difficulty focusing on activities, organizing and finishing tasks, managing one's time, following instructions and/or being overly restless, "on the go," and perceived as not thinking before acting or speaking

advance directive:

legal documents that express someone's desires regarding treatments should then be unable to communicate. A living will and a healthcare power of attorney constitute an advance directive

adverse drug reactions (ADRs):

unintended, unpleasant, and/or harmful reactions to a medicinal product

aerobic training:

exercise that increases the body's capacity to use oxygen

aerobic:

biological energy production using oxygen

age-related hearing loss:

loss of hearing with advancing age; some loss of hearing may be caused by exposure to loud noise earlier in life

age-related macular degeneration (AMD):

loss of vision as a result of death of cells in a region of the eye called the macula; loss of vision progresses slowly over several years

aging:

normal changes in body functions that begin after sexual maturity and continue until death

alcohol use disorder:

alcohol consumption that causes distress or harm; also known as alcoholism or alcohol abuse

alcoholism:

loss of control over drinking alcohol

allergens:

foreign substances that trigger an allergic response by the immune system

alternative medicine:

a therapy or healing procedure that is used *instead of* Western, scientific medical treatments

Alzheimer's disease (AD):

a common cause of senile dementia and other symptoms, eventually leading to death

amino acids:

compounds containing nitrogen that are the building blocks of protein

amniocentesis:

a procedure in which amniotic fluid is removed from the uterus and tested to determine whether genetic or anatomical defects exist in the fetus

amphetamines:

synthetic drugs that stimulate the central nervous system and sometimes produce hallucinogenic states

amyloid protein:

an abnormal protein in the brain of patients with Alzheimer's disease

anabolic steroids:

synthetic derivatives of the male hormone testosterone.

anaerobic:

biological energy production without using oxygen

anaphylactic shock:

a severe allergic reaction involving the whole body that can cause death

androgenic anabolic steroids:

synthetic male hormones used to increase muscle size and strength

aneurysms:

ballooning out of a vein or artery

angina pectoris:

medical term for chest pain caused by coronary heart disease; a condition in which the heart muscle doesn't receive enough blood, resulting in chest pain

anorexia nervosa:

disorder occurring most commonly in adolescent females, characterized by abnormal body image, fear of obesity, and prolonged refusal to eat, sometimes resulting in death

antibiotics:

antibiotics (antimicrobials): chemicals that prevent infecting organisms from causing disease

antibodies:

proteins that recognize and inactivate viruses, bacteria, and other organisms and toxic substances that enter the body

antigens:

foreign proteins on infectious organisms that stimulate an antibody response

antioxidants:

vitamins that have the capacity to neutralize the effects of chemicals called *free radicals*, which can damage biological structures via chemical oxidation

anxiety:

the fear of an imaginary threat

aorta:

the large artery that transports blood from the heart to the body

aromatherapy:

use of fragrant extracts of plants to promote healing

arteries:

any of a series of blood vessels that carry blood from the heart to all parts of the body

arteriosclerosis:

hardening of the arteries

arthritis:

a variety of chronic diseases involving inflammation, stiffness, and pain in joints of the body

asthma:

a chronic disease involving inflammation and narrowing of the airways that makes it difficult to breathe

atherosclerosis:

a disease process in which fatty deposits (plaques) build up in the arteries and block the flow of blood

atrial fibrillation (“a-fib”):

rapid, erratic contraction of the upper chambers of the heart

autism spectrum disorders (ASD):

a group of conditions characterized by degrees of impairment in interpersonal interaction

autogenic training:

the use of autosuggestion to establish a balance between the mind and body through changes in the autonomic nervous system

autoimmune diseases:

mistakes in the functioning of the immune system that cause it to attack tissues in the body

autonomic nervous system (ANS):

the special group of nerves that control some of the body's organs and their functions

average life expectancy:

average number of years a person can expect to live

avoidance:

distracting oneself from feeling anxious but not doing anything to address the cause

Ayurveda:

a traditional form of preventive medicine and healing, involving mind, body, and spirit, practiced in India for thousands of years

B

B cells:

cells of the immune system that produce antibodies

bacterial vaginosis (BV):

a vaginal infection, often caused by *Gardnerella vaginalis*

bariatric surgery:

weight loss surgery

basal cell carcinoma:

a form of skin cancer that usually can be removed surgically

basal metabolic rate (BMR):

the amount of energy needed to keep the body functioning while at rest

basal metabolism:

the minimum amount of energy needed to keep the body alive

bender:

several days of continued drinking

benign tumors:

tumors whose cells do not spread to other parts of the body

binge drinking:

For men, consuming five or more, and a woman consuming four or more, drinks in about two hours

binge eating disorder:

an uncontrolled consumption of large quantities of food in a short period of time, even if the person does not feel hungry

biofeedback:

using an electronic device to “feed back” information about the body to alter a particular physiological function

biomagnetic therapy:

use of magnetic fields to treat pain, ailments, and diseases

biomonitoring:

measurement of environmental chemicals present in the body that may harm health

biopsy:

removal of cells from a tumor for examination under a microscope

bipolar disorder:

episodes of depression followed by episodes of mania

bisphenol-A (BPA):

chemical used to manufacture polycarbonate plastics; may cause abnormal brain development in fetuses and birth defects

blackout:

failure to recall normal or abnormal behavior or events that occurred while drinking

blood alcohol concentration (BAC):

the amount of alcohol in the blood

blood pressure:

measurement of the force with which the heart pushes blood through the circulatory system

body composition:

the relative amounts of the body's major components

body dysmorphic disorder:

a preoccupation with an imagined defect in one or more of one's body parts

body image:

a person's mental image of his or her body

body mass index (BMI):

a measure of body fatness, calculated by dividing body weight (in kilograms) by the square of height (in meters)

bulimia:

serious disorder, especially common in adolescents and young women, marked by excessive eating, often followed by self-induced vomiting, purging, or fasting

C**caffeine:**

a natural stimulant found in a variety of plants used in coffee, tea, chocolate, and soft drinks

calorie dense:

food items that contain considerable calories but are of little nutritional value

calorie:

the amount of energy required to raise 1 g of water from 14.5°C to 15.5°C

cancer susceptibility gene:

gene responsible for increasing the risk of developing a particular type of cancer

cancer:

unregulated multiplication of cells in the body

cannabidiol (CBD):

cannabis plant product with nonpsychoactive properties but medicinal effects such as pain relief

capillaries:

extremely small blood vessels that carry oxygenated blood to tissues

carbohydrates:

biological substances composed of one or more sugar molecules

cardiac catheterization:

visualization of blocked coronary arteries by using a catheter and monitoring blood flow in coronary arteries; a dye is injected through the catheter

cardiologist:

a physician who specializes in diseases of the heart

cardiopulmonary resuscitation (CPR):

an emergency lifesaving procedure used to revive someone who has stopped breathing or suffered cardiac arrest

cardiorespiratory fitness:

the degree to which the body can supply sufficient fuel and oxygen to produce sustained, effortful physical activity

cardiovascular disease (CVD):

any disease that causes damage to the heart or the body's blood vessels

carotid endarterectomy:

removal of fatty deposits in arteries in the neck to prevent a stroke

cell-mediated immunity:

the response of T cells to infections

cellulose:

a carbohydrate forming the skeleton of most plant structures and plant cells; the most abundant polysaccharide in nature and the source of dietary fiber

cervix:

the opening in the lower part of the uterus that permits sperm to pass from the vagina to the uterus and a fetus to the outside at birth

challenge situations:

positive events that may involve major life transitions and may cause stress

chemical carcinogen:

a chemical that damages cells and causes cancer

chemotherapy:

use of toxic chemicals to kill cancer cells and treat some forms of cancer

chi:

universal energy that must be distributed harmoniously throughout the mind–body to attain and maintain health; also known as *qi*

child maltreatment:

physical or mental injury, sexual abuse or exploitation, maltreatment, or neglect of a child by a person who is responsible for the child's welfare

chiropractic:

an alternative medicine that uses manipulation of the spine and joints for healing

chlamydia:

a sexually transmitted bacterial infection of the genitals, anus, mouth, eyes, and occasionally the lungs

chlorofluorocarbons (CFCs):

chemicals formerly used as coolants that are released into the atmosphere and that are responsible for destroying

stratospheric ozone

cholesterol:

a fatlike compound occurring in bile, blood, brain, nerve tissue, liver, and other parts of the body

chorionic villus sampling:

a prenatal procedure used to determine whether genetic or anatomical defects exist in a fetus; an alternative to amniocentesis

chromosomes:

threadlike structures in the nuclei of cells that carry an individual's genetic information

chronic disease:

a disease that persists for years or even a lifetime

chronic traumatic encephalopathy (CTE):

destruction of nerve cells in the brain from repeated brain injury due to collisions and falls

club drugs:

psychoactive chemicals used at parties, dances, festivals, and raves to enhance social experiences and increase sensory stimulation

cocaine:

a stimulant drug, obtained from the leaves of the coca shrub, that causes feelings of exhilaration, euphoria, and physical vigor

codependency:

a relationship pattern in which the nonaddicted family members identify with the alcoholic

cognitive behavioral therapy (CBT):

treatment of psychological distress by examining and changing thoughts that underlie it

communicable disease:

an infectious disease that is usually transmitted from person to person

complementary medicine:

an alternative therapy that is used *along with* conventional medicine.

complex carbohydrates:

a class of carbohydrates called polysaccharides; foods composed of starch and cellulose

concussion:

a blow to the head that causes injury, temporary loss of consciousness, and possibly a period of amnesia upon awakening

condom:

a latex or polyurethane sheath worn over the penis (male condom) or inside the vagina (female condom); can be both a barrier method of contraception and act as a prophylactic against sexually transmitted diseases

congenital (birth) defect:

any abnormality observed in a newborn that occurred during development

contact dermatitis:

an allergic reaction of the skin to something that is touched

contraindication:

any medical reason for not taking a particular drug

coping strategies:

ways people devise to prevent, avoid, or control the emotional distress of unfulfilled needs

coping:

efforts to manage a stressful situation regardless of whether those efforts are successful

coronary arteries:

two arteries arising from the aorta that supply blood vessels to the heart muscle

coronary artery bypass graft (CABG):

surgery to improve blood supply to the heart muscle by replacing the damaged portion of the blocked artery with a graft

coronary heart disease (CHD):

disease caused by fatty deposits in the heart's coronary arteries that impede or completely block the transport of oxygen and nutrients to the heart muscle cells

cosmetic surgery:

surgery performed not for any medical condition but solely to enhance appearance or correct visible effects of aging

creatine:

a natural substance in skeletal muscle tissue required for muscle contraction, which can also be purchased as a dietary supplement

cross-training:

incorporating more than one activity into a regular activity plan

cytokines:

small molecules that coordinate the activities of B cells and T cells

D

date label:

a manufacturer's or a store's assessment of when a food product is at peak quality; not related to when the product poses a potential health risk

decibel (dB):

a measure of noise level

defibrillator:

an electrical device that can restart a heart that has stopped beating by delivering electrical shocks to it

delirium tremens (DTs):

hallucinations and uncontrollable shaking caused by withdrawal of alcohol in alcohol-dependent individuals

delta-9-tetrahydrocannabinol (THC):

the principal psychoactive substance in marijuana

denial:

refusal to admit you (or someone else) have a drinking problem

deoxyribonucleic acid (DNA):

the chemical substance that carries all of a person's genetic information in chromosomes in cells

determinants of health and wellness:

consist of personal, social, economic, and environmental factors that affect individual, community, and world health

diagnosis:

the cause of a disease or illness as determined by a physician

diastole:

the pressure in the arteries when the heart relaxes (the lower number)

Dietary Reference Intakes (DRIs):

recommended nutrient intakes intended to prevent chronic diseases

dietary supplements:

products that provide one or more of the 40 essential nutrients or nonessential vitamins, minerals, enzymes, amino acids, herbs, hormones, and nucleic acids

direct-to-consumer advertising (DTCA):

the marketing of prescription drugs to consumers to stimulate demand for a drug

distress:

stress resulting from unpleasant stressors

double-blind placebo-controlled trial:

when neither the person receiving the drug nor the person administering the drug knows whether patients receive a placebo or the drug

drug abuse:

persistent or excessive use of a drug without medical or health reasons

drug addiction:

physical and psychological dependence on a drug, substance, or behavior

drug hypersensitivity:

an allergic reaction to a drug

drug:

a single chemical substance that alters one or more of the body's biological functions

dysthymia:

a long-lasting, mild form of depression

E

e-cigarettes:

electronic devices that deliver nicotine, flavorings, and chemicals to the user through inhaled vapors

Ecstasy (MDMA):

a club drug with both stimulant and pleasurable effects

elder abuse:

physical, sexual, or emotional maltreatment or financial exploitation of an adult aged 60 or older

electrocardiogram (EKG):

a test that shows the rate and rhythm of the heartbeat

electromagnetic fields (EMFs):

a form of radiation produced by electrical power lines and appliances that may increase the risk of cancers

embryonic stem cells:

cells derived from human fertilized eggs and grown in laboratory dishes; stem cells have the capacity to differentiate into many different tissues and organs

emergency contraception:

using contraceptive hormones or an IUD to interrupt a possible pregnancy

emerging infectious diseases:

infections that newly appear, or reemerge, within a vulnerable population of people or known infections that are suddenly spreading rapidly.

emotional wellness:

understanding emotions and knowing how to cope with problems that arise in everyday life and how to manage stress

emotion-focused coping:

appraising and accepting a stressful situation as not immediately changeable and adopting an attitude that lessens anxiety and brings comfort

emotions:

patterns of brain activity that can arise spontaneously or in response to what is experienced, has been experienced, or believed to be experienced.

enabling:

denial of, abetting, or excusing another's addictive behaviors

endocrine disruptors:

are natural or industrial chemicals that mimic or interfere with the body's intrinsic endocrine (hormone) system

endurance:

the ability to move an object without becoming quickly fatigued

energy balance:

when energy consumed as food equals the energy expended in living

environment:

all external physical factors that affect us

environmental wellness:

living in an environment characterized by clean air, water, and land that also supports basic human needs and is free of interpersonal violence and the threat of climate change

ergogenic aids:

substances used to increase strength and endurance

erythropoietin:

a hormone that increases the number of red blood cells, thus increasing the body's ability to carry oxygen to tissues

essential (primary) hypertension:

high blood pressure that is not caused by any observable disease

essential amino acids:

amino acids that cannot be synthesized by the body and must be provided by food

essential fat:

necessary body fat required for normal physiological functioning

essential nutrients:

chemical substances obtained from food and needed by the body for growth, maintenance, or repair of tissues; not made by the body; must be obtained from food

ethyl alcohol (ethanol):

the consumable type of alcohol that is the psychoactive ingredient in alcoholic beverages; often called grain alcohol

eustress:

stress resulting from pleasant stressors

F

failure rate:

likelihood of becoming pregnant if using a birth control method for 1 year

fallopian tubes:

a pair of female, pelvic anatomical structures in which fertilization takes place

familial hyperlipidemia (FH):

an inherited disease causing extremely high levels of cholesterol in the blood

fat substitutes:

chemicals added to packaged foods to provide the taste and texture of fat but few or no calories

fat-soluble vitamins:

soluble in fat; there are four fat-soluble vitamins

fatty acids:

naturally occurring in fats, either saturated or unsaturated (monounsaturated or polyunsaturated)

female athlete triad:

combination of disordered eating, cessation of menstruation (amenorrhea), and weakened bones (osteoporosis)

fertility awareness methods:

methods of birth control in which a couple charts the cyclic signs of the woman's fertility and ovulation or uses basal body temperature, mucus changes, and other signs to determine fertile periods

fertilization:

the fusion of a male's sperm cell with a female's ovum to form a fertilized egg

fetal alcohol syndrome (FAS):

birth defects and mental disabilities caused by ingestion of alcohol by the mother during pregnancy

fiber:

a group of compounds that make up the framework of plants; fiber cannot be digested

financial wellness:

attaining and maintaining resources to meet physical, psychological, and social needs by planning for the future, preparing for unforeseen financial difficulties, and being aware of others' financial values, needs and circumstances

firearm violence:

nonmilitary violence committed with the use of a gun with or without criminal intent

flexibility:

the degree to which one can rotate, bend, and twist a part of the body

flight-fight-freeze response:

a defensive reaction that prepares the organism for conflict or escape by triggering hormonal, cardiovascular, metabolic, and other changes

food allergies:

allergic responses to something that is eaten

free radicals:

highly reactive molecules that can damage cellular structures

fructose:

a simple sugar found in fruits and honey

functional food:

a food to which additional vitamins, minerals, herbs, or other substances are added to allow the manufacturer to make health claims

G

gamma irradiation:

nonchemical method of food preservation

gamma-hydroxybutyrate (GHB):

a dangerous club drug with unpleasant side effects

gene therapy:

a technique for replacing defective genes with normal ones in certain tissues of a person affected with a hereditary disease

general adaptation syndrome (GAS):

a three-phase biological response to stress

genes:

biological entities responsible for the transmission and proper functioning of cells

genetic counseling:

information to help prospective parents evaluate the risks of having or delivering a child with a genetic abnormality

genetic testing:

medically supervised procedures that identify changes in chromosomes, genes, or proteins to confirm or rule out a suspected genetic condition or help determine a person's chance of developing or passing on to children a genetic disorder

genetically modified food:

agricultural plants and animals into which one or more genes from other organisms have been inserted (also called *genetically modified organisms*, or GMOs)

genetics:

refers to biological entities responsible for the transmission of hereditary traits

genome editing:

a method to precisely add, change, or remove segments of DNA

glucose:

the principal source of energy in all cells; also called dextrose

gluten:

a mixture of proteins that occur naturally in wheat, rye, barley and crossbreeds of these grains, which can damage the small intestine

glycogen:

the form in which carbohydrate is stored in humans and animals

gonorrhea:

a sexually transmitted bacterial infection of the genitals, anus, mouth, and eyes

greenhouse effect:

the ability of atmospheric carbon dioxide to reflect heat radiated from Earth back to Earth and to thereby raise Earth's temperature globally

guided imagery:

using verbal suggestions to create one's own mental images that produce relaxation and feelings of harmony, and reduce stress

H**habituation:**

psychological dependence arising from repeated use of a drug

hallucinogens:

psychoactive substances that alter sensory processing in the brain, producing visual or auditory sensations that are not real (i.e., that are hallucinatory)

hangover:

unpleasant physical sensations resulting from excessive alcohol consumption

harm-and-loss situations:

stressful events that include death, loss of property, injury, and illness

hate crime:

any unlawful act committed against a person, group, or place that is motivated by hate or bias

Health Belief Model:

health behavior change is a function of a person's perceived risks for behaving as usual and benefits from change

health disparities:

differences in health status based on race, income, educational attainment, and access to healthy food, healthy environments, and quality medical care

health insurance:

a system intended to pay some or all of the costs of a person's medical, surgical, and hospital care

health maintenance organization (HMO):

an organization (either nonprofit or for-profit) of physicians, hospitals, and support staff that provides medical services to members

health status:

an individual's state of health and wellness, accounting for the presence of disease, disability, and the individual's self-rated assessments of overall physical, mental, and social health

healthcare disparity:

a higher burden of illness, injury, disability, or mortality
experienced by one population group relative to another group

healthcare power of attorney:

designates someone to make healthcare decisions for you if you
are unable to communicate

heart attack:

death of, or damage to, part of the heart muscle caused by an
insufficient blood supply

heart failure:

when the heart is weakened to the degree it cannot pump blood
throughout the body

heavy alcohol use:

binge drinking on 5 or more days in the past month

hedonic eating system:

motivation to eat by the desire to experience a psychological
reward, or pleasure from consuming food

hemicellulose:

substances found in plant cell walls that are composed of
various sugars chemically linked together

hepatitis B virus (HBV):

virus that causes disease of the liver

herbal medicines:

materials derived from plants and other organisms that are
made into teas, powders, and salves to treat diseases and
injuries

hereditary (genetic) disease:

any disease resulting from the inheritance of defective genes or
chromosomes from one or both parents

herpes simplex:

a sexually transmitted viral infection of the genitals, anus, mouth, and eyes, characterized by the appearance of wet, open, painful sores at the site of the infection

high-density lipoprotein (HDL):

the carrier of cholesterol from tissues to the liver for removal from the circulation; carrier of “good” cholesterol

high-intensity drinking:

drinking that is two to three times the threshold amounts of binge drinking

histamine:

a chemical released by cells in an allergic response; causes inflammation

histocompatibility:

the degree to which the antigens on cells of different persons are similar

homeopathy:

an alternative medicine that administers very dilute solutions of substances that mimic the patient’s symptoms

homeostatic eating system:

integrated neurological and hormonal control of eating behavior based on the body’s need for energy (calories)

homeostatic sleep drive:

sleep–wake cycle is controlled by brain mechanisms

hormonal contraceptives:

pills, a skin patch, a vaginal insert, and injections that contain two kinds of synthetic hormones that are chemically similar to a woman’s natural ovarian hormones, estrogen and progesterone

hormonal implant:

1.5-inch hormone-containing plastic rod placed under the skin, where it remains for 3 years to prevent pregnancy

hormone replacement therapy (HRT):

administration of estrogen to menopausal and postmenopausal women to help prevent symptoms of menopause, osteoporosis, and heart disease

hormones:

chemicals produced in the body that regulate body functions

hospice:

a place for terminally ill patients to spend the time before death in an environment that attends to their physical, emotional, and spiritual needs but does not administer any further treatments; hospice care also can be given in a patient's home

human growth hormone (HGH or GH):

a naturally occurring pituitary hormone

human immunodeficiency virus (HIV):

the virus that causes AIDS

human leukocyte antigens (HLAs):

antigens that are measured to determine the suitability of an organ for transplantation from donor to recipient

human microbiome:

the total composition of bacteria, fungi, viruses, and other microorganisms that inhabit a human body

human papilloma virus (HPV):

the causative cause of anogenital warts and occasionally cervical cancer

humoral immunity:

the response of B cells to infections

hypertension:

high blood pressure

hypnosis:

state of concentration and focused attention

hypnotherapy:

the use of hypnosis to treat sickness

hypnotics:

central nervous system depressants used to induce drowsiness and encourage sleep

hypothalamo-pituitary-adrenal (HPA) axis:

a coordinated physiological response to stress involving the hypothalamus of the brain and the pituitary and adrenal glands

I

image visualization:

use of mental images to promote healing and change behaviors

immune system:

an interacting system of organs and cells that protect the body from infectious organisms and harmful substances

immunizations:

vaccinations to prevent a variety of serious diseases caused by both bacteria and viruses

immunosuppressive drugs:

drugs to suppress the functions of the immune system (e.g., after organ transplants)

immunotherapy:

medically enhancing the body's immune system to fight cancer

incidence:

the number of new cases of a particular disease

infection:

the entry, survival, and reproduction of nonself-organisms in one's body

infectious disease:

a disease caused by a parasite

ingredients label:

label on a manufactured food that lists the ingredients in descending order by weight

inhalants:

vaporous substances that, when inhaled, produce alcohol-like intoxication

injury epidemiology:

the study of the occurrence, causes, and prevention of injury

insoluble fiber:

cannot be dissolved in water

insomnia:

prolonged inability to obtain adequate sleep

integrative medicine:

combination of the practice of scientific, Western medicine with alternative medicines that are safe and effective for patients

intellectual wellness:

having a mind open to new ideas and concepts

intermittent anxiety:

relatively short term anxiety readily identified as a response to a specific upcoming event or situation; remits when the feared situation or event passes.

interpersonal violence:

physical or verbal behavior in which the intent is to harm, injure, or destroy someone or something

intimate partner violence (IPV):

physical, sexual, or psychological harm by a current or former intimate partner or spouse

intrauterine device (IUD):

a flexible, usually plastic, device inserted into the uterus to prevent pregnancy

ionizing radiation:

radiation, such as X-rays, that can damage cells and cause cancer; also used to treat cancer

isometric training:

strength training by pushing against an immovable object

K**karyotype:**

visual display of all of a person's chromosomes that can detect chromosomal abnormalities characteristic of inherited diseases

ketamine:

an anesthetic used as a club drug

kilocalorie:

unit of energy; the amount of heat needed to raise 1 kilogram of water 1°C, equivalent to 1,000 calories

L**lactase:**

enzyme secreted by glands in the small intestine that converts lactose (milk sugar) into simple sugars

lactose intolerance:

the biological inability to digest the milk sugar lactose

lactose:

a sugar formed by glucose and galactose chemically bonded together; found primarily in milk

lecithin:

an essential component of cell membranes

leukocytes:

white blood cells that fight infections

lifestyle diseases:

negative health conditions from personal behaviors such as cigarette smoking, poor diet, and a sedentary lifestyle

linoleic acid:

an essential fat that must be obtained from food

lipids:

fats such as cholesterol and triglycerides

lipoproteins:

spherical particles that transport cholesterol and fat (TG) in the blood

liposuction:

surgery used to remove fat under the skin to reshape parts of the body

living will:

a legal document that expresses your wishes regarding treatment if you become unable to make your own medical decisions

lovingkindness meditation (LKM):

reciting positive phrases toward oneself or another; also known as *metta*

low-density lipoprotein (LDL):

the carrier of “bad” cholesterol in blood

lowest user failure rate:

how well a method performs when used both as intended and consistently

lymph nodes:

nodules spaced along the lymphatic vessels that trap infectious organisms or foreign particles

lymphatic system:

a system of vessels in the body that trap foreign organisms and particles; the immune system is part of the lymphatic system

M

macrophages:

specialized cells that destroy and eliminate foreign particles and microorganisms from the body

magnetic resonance imaging (MRI):

use of a strong magnetic field to produce images of internal parts of the body; especially useful for soft tissues

major depressive disorder:

a long-lasting depressive state of episodes of deep depression that is not self-limiting

malignant tumors:

tumors whose cells spread throughout the body

mammogram:

X-ray picture used to detect tumors in the breast

managed care:

systems of health care in which the primary goal is to reduce costs

mandala:

an artistic, religious design used as an object of meditation

mantra:

a sound or phrase that is repeated in the mind to help produce a meditative state

marijuana:

the dried leaves, flowers, stems, and seeds from the plants *Cannabis sativa* and *Cannabis indica*

maximum human life span:

the theoretical maximum number of years that individuals of a species can live

medical aid in dying:

a physician assistance to help a patient who no longer desires to live because of pain or an incurable illness to die

medical model:

interprets health in terms of the absence of disease and disability

medicalization:

medical treatment of conditions, behaviors, or traits that generally were not regarded as illnesses or medical problems

medication abortion:

nonsurgical abortion using specific medications to stop pregnancy

medicine:

drugs used to prevent, treat, or cure illness; aid healing; or suppress symptoms

meditation:

focusing awareness on a self-produced inner sound (“mantra”) or an external sound, or image, or one’s breathing to lessen attentiveness to external stimuli

melanoma:

a particularly dangerous form of skin cancer

melatonin:

hormone that promotes sleep

menstrual cycle:

near monthly production of fertilizable ova

menstruation:

sloughing of the lining of the uterus and associated small blood vessels

mental health:

a sense of optimism, vitality, and well-being, and intentional behaviors that lead to productive activities, fulfilling relationships with others, and the ability to adapt to change and to cope with adversity

mental illness:

alterations in thinking, emotions, and/or intentional behaviors that produce psychological distress and/or impaired functioning

meridians:

the channels along the body where energy flows and where acupuncture points are located

mesothelioma:

a form of lung cancer caused by asbestos

metabolic equivalents (METs):

per minute multiples of the amount of energy used while lying still

metabolic syndrome:

a model embracing five risk factors that puts people who have at least three risk factors at risk for cardiovascular disease, diabetes, and premature death

metabolism:

the process of obtaining energy and matter from the chemical breakdown of molecules obtained from food or from the body

metastasis:

the process by which cancer cells spread throughout the body

minerals:

materials such as sodium, potassium, and chlorine that are essential for maintaining cell membranes, conducting nerve impulses, and contracting muscles

moderate drinking:

For men, defined as having an average of two or fewer drinks per day (14 drinks per week); for women, defined as having no more than one drink per day (7 drinks per week)

molluscum contagiosum:

a virus-caused STD

monounsaturated fatty acid (MUFA):

carries one less than all the hydrogen atoms it possibly could

multiple sclerosis:

an autoimmune disease that affects the central nervous system

mutations:

permanent changes in the genetic information in a cell; only mutations in sperm and eggs are inherited

myelin:

a substance that sheathes and insulates nerve fibers in the brain and spinal cord

myocardium:

muscular wall of the heart that contracts and relaxes

MyPlate:

a graphic to remind people of the composition of a healthy diet

N

naturopathy:

an alternative medicine that uses nutrition, herbs, massage, and other techniques

newborn screening:

testing newborns for the presence of abnormal genes

nicotine replacement therapy (NRT):

the use of nicotine-containing products such as skin patches and chewing gum to help a smoker end smoking

nicotine:

a potent nervous system stimulant in tobacco leaves

nocebo effect:

the opposite of placebo effect; a harmless substance that has harmful, undesirable, and adverse effects on health

nutrient dense:

food items that are high in nutrition in proportion to their calorie content

Nutrition Facts label:

label on a manufactured food that lists the quantity of certain nutrients in the food and the percent daily value for those nutrients

nutritional calorie:

unit of energy; often used interchangeably with the term kilocalorie

O

obesity:

storage fat exceeding 30% of body weight

occupational wellness:

enjoyment of what you are doing to earn a living and contribute to society

ongoing anxiety:

long lasting, physiologically and psychologically intense anxiety which can intensify over time, interfere with many parts of life, and impair daily functioning and health.

open-heart surgery:

surgery performed on the opened heart while the blood supply is diverted through a heart–lung machine

opiates:

central nervous system depressants derived from the opium poppy

optimism:

the thought process of imagining a high probability of attaining a goal

osteopathy:

an alternative medicine that uses manipulation and medicines for healing

osteoporosis:

a condition in older people, particularly women, in which bones lose density and become porous and brittle

ovaries:

a pair of almond-shaped structures in the female pelvic cavity that produce ova (eggs) and sex hormones

overload:

the feeling that there are too many demands on one's time and energy from being confronted with too many challenges

over-the-counter (OTC) drugs:

medications available for purchase at stores without a doctor's prescription

overuse injuries:

injuries to muscles, tendons, ligaments, and joints resulting from too much exercise

oxidation:

the chemical term for the process by which oxygen is used to produce energy for life processes.

ozone layer:

a layer of ozone molecules located in the stratosphere in a diffuse band extending from 10 to 30 miles above Earth's surface

P

pacemaker:

an electrical device implanted in the chest to control irregular heartbeats

palatable foods:

those which create the sensations of salty, fatty, and sweet

parasomnias:

activities that interrupt restful sleep

Parkinson's disease (PD):

chronic and progressive neurodegenerative disease; second most common neurodegenerative disease among older persons

particulate matter (PM):

consists of microscopic particles that released into the air principally from the burning of diesel fuel, coal, and other fossil fuels

pathogen:

a disease-causing organism

pedometer:

a step counter

penicillin:

an antibiotic produced by mold and capable of curing many bacterial infections

percent daily value (PDV):

percentage of the recommended daily amount of a particular nutrient found in a food

percutaneous transluminal coronary angioplasty (PTCA):

a procedure to open blocked arteries

pessimism:

the thought process of imagining a low probability of attaining a goal

pesticide:

a chemical that kills unwanted plants and animals

pharmacogenetics:

tailoring drugs to a particular individual to match her or his biology

phencyclidine (PCP):

drug that, depending on the route of administration and dose, can be a stimulant, depressant, or hallucinogen; originally developed as an animal anesthetic

phobia:

a powerful and irrational fear of something

photochemical smog:

air pollution from the action of sunlight on emissions from motor vehicles and industrial sources

phthalates:

chemicals used in the manufacture of various plastics; may cause abnormal genital development in males and premature breast development in girls

physical activity level (PAL):

a measure of the amount of energy expended per day over and above that used for basal metabolism

physical dependence:

a physiological state that depends on the continuous presence of a drug; absence of the drug may cause discomfort, nervousness, headaches, and sweating (withdrawal symptoms) and sometimes death

physical wellness:

maintaining a healthy body by eating right, exercising regularly, avoiding harmful habits, and making informed, responsible decisions about your health

phytochemicals:

non-nutrient health-promoting chemicals produced by plants

Pilates:

a system of stretching and strengthening exercises

placebo effect:

healing that results from a person's belief in a treatment that has no medicinal value

plaque:

deposit of fatty substances in the inner lining of arteries

plumbism:

disease caused by lead poisoning

poison:

any chemical substance that causes illness, injury, or death

polyunsaturated fatty acid:

carries at least two fewer hydrogen atoms than it would if saturated

posttraumatic stress disorder (PTSD):

physical and mental illnesses resulting from severe trauma

precision medicine:

tailoring treatments to the genetic makeup of individual patients; also called *personalized medicine*

preferred provider organization (PPO):

physicians who belong to the organization provide medical care at reduced costs that are negotiated by the organization

prevalence:

the number of people within a population with a particular disease

problem-focused coping:

appraising a stressful situation as changeable and making and attempting a plan for changing something to improve things

processed foods:

industrial products derived from natural foods to which salt, sugar, oils and fats, and other chemicals are added to modify taste and consistency

proof:

a number assigned to an alcoholic product that is twice the percentage of alcohol in that product

protein complementarity:

combining sources of dietary protein such that amino acid deficiencies in one are counterbalanced by abundances in another

proteins:

complex biological chemicals, each with an important role in the structure, function, and regulation of the body's tissues and organs

psychoactive:

any substance that primarily alters mood, perception, and other brain functions

psychological dependence:

dependence that results because a drug produces pleasant mental effects

psychosomatic:

physical illnesses brought on by negative mental states such as stress or emotional upset

pubic lice:

insects that live on the hair shafts in the pelvic region

Q

quackery:

promotion and sale of unapproved and worthless products, especially for medical problems and health enhancement

R

radiation therapy:

use of high-energy radiation, such as X-rays, to kill cancer cells and treat some forms of cancer

radon:

a radioactive gas found in some homes that can increase the risk of cancer

range of motion:

the amount of rotating, bending, or twisting allowed by the anatomy of a joint

rape trauma syndrome:

Immediate and long-term psychological difficulties, including PTSD, from having been raped

rape:

nonconsensual sexual behavior, generally penile penetration of a bodily orifice

rapid eye movement (REM):

stage of sleep in which dreams occur

reactive hypoglycemia:

occurring after the ingestion of carbohydrate, with consequent release of insulin

rebound effect:

the reemergence of symptoms for which a drug is administered after the drug is suddenly stopped or the dose lessened

receptors:

proteins on the surface or inside of a cell to which a drug or natural substance can bind and thereby affect cell function

relative perceived exertion:

awareness of one's relative response to exercise

relaxation response:

the physiological changes in the body that result from mental relaxation techniques

repetitive motion disorders:

disorders caused by repeated stress to a body part; carpal tunnel syndrome is a repetitive motion disorder

resilience:

defined by the APA as the process of adapting in the face of adversity, trauma, tragedy, threats, or significant sources of stress

rheumatic heart disease:

damage to heart valves from bacterial infection

RICE:

an acronym for rest, ice, compression, elevation; the first aid measures for sports injuries

Rohypnol:

a powerful tranquilizer used as a club drug

S

safe days:

days in the menstrual month distant from when fertilizable ova are likely to be produced

saturated fat:

generally solid at room temperature; comes from animal sources

scabies:

an infestation of the skin by mites

seasonal affective disorder (SAD):

depressive symptoms that appear in autumn or winter and remit spontaneously in spring

secondary hypertension:

high blood pressure caused by a recognizable disease

secondhand binge effects:

negative experiences caused by another's binge drinking

second-hand smoke:

tobacco smoke released into a smoker's surroundings

sedative:

central nervous system depressant used to relieve anxiety, fear, and apprehension

sedentary behavior:

a pattern of living that lacks sufficient physical activity for good health

self-esteem:

the judgment one places on one's self-worth

senile dementia:

loss of cognitive functions in elderly people

sexual assault:

the combination of nonconsensual sexual penetration (rape) and nonsexual violence, such as battery, the threat of harm, or homicide

sexual violence:

violent actions that include rape, incest, attempted rape, and unwanted sexual touching

sexually transmitted disease (STD):

an infection or infestation caused by a biological agent (e.g., virus, bacterium, insect) that is transferred from person to person by sexual interaction

shaken-baby syndrome (SBS):

a form of child abuse in which an infant is violently shaken by an adult

sick building syndrome:

collection of symptoms reported by workers in some modern buildings

side effects:

unintended and often harmful actions of a drug

simple sugars:

a class of carbohydrates called monosaccharides; all carbohydrates must be reduced to simple sugars to be digested

sinoatrial node:

the region of the heart that produces an electrical signal that causes the heart to contract

smog:

air polluted by chemicals, smoke, particles, and dust

social support:

resources that one receives from others, particularly people in one's immediate social network with whom one has emotional bonds and/or social ties

social wellness:

ability to perform social roles effectively, comfortably, and without harming others

soluble fiber:

can be dissolved in water

spermicide:

a chemical that kills sperm; particularly foams, creams, gels, and suppositories used for contraception

spiritual wellness:

state of balance and harmony with yourself and others

squamous cell carcinoma:

cancer of the top layer of skin; most are curable if removed early

stalking:

behavior that causes victims to feel a high level of fear of physical or sexual violence

starch:

complex chain of glucose molecules

statins:

a class of drugs that block synthesis of cholesterol in the liver and reduce the amount of cholesterol in the blood

stimulants:

substances that increase the activity of the central nervous system

storage fat:

also called depot fat; energy stored as fat in various parts of the body

strength training:

the use of resistance to increase one's ability to exert or resist force for the purpose of improving performance

stress:

the sum of physical and emotional reactions to any stimulus that disturbs the harmony of body and mind

stressor:

any physical or psychological situation that produces stress

stroke:

death of brain cells due to an insufficient supply of blood to the brain, resulting in loss of muscle function, loss of speech, or other symptoms; also called a *brain attack*

subluxation:

misalignment of a vertebra from its correct position

sucrose:

common refined table sugar; a molecule of glucose and a molecule of fructose chemically bonded together

sulfites:

used as preservatives for salad, fresh fruits and vegetables, wine, beer, and dried fruit; in susceptible individuals, especially those with asthma, they can cause a severe reaction

surgical sterilization:

rendering a person virtually unable to have children but with no effect on the ability to engage in or enjoy sex

syphilis:

a sexually transmitted bacterial infection caused by the bacterium *Treponema pallidum*

systole:

the pressure in the arteries when the heart contracts (the higher number)

T

T cells:

cells of the immune system that attack foreign organisms that infect the body

t'ai chi ch'uan:

a Chinese martial arts system of movements that enhances freedom of movement and focus of mind

tar:

yellowish-brown residue from tobacco combustion and a documented cause of lung cancer

target heart rate:

the heart rate during strenuous exercise associated with inducing the training effect

tau tangles:

aggregates of a brain protein called tau; a diagnostic indicator for Alzheimer's disease

telomeres:

DNA at the ends of chromosomes that protect the integrity of genetic information during cellular replication

teratogen:

any environmental agent or drug that alters development of a fetus

Theory of Reasoned Action or Theory of Planned Behavior:

proposal that changing a health behavior begins with an intention to adopt a new behavior

therapeutic massage:

promotes relaxation and healing by massage of the skin and muscles

threat situations:

events that cause stress because of a perception that harm or loss may occur

tinnitus:

persistent ringing in the ears, often caused by repeated or sudden exposure to loud noises

tolerance:

a condition in which increased amounts of a drug or increased exposure to an addictive behavior is required to produce desired effects

training effect:

beneficial physiological changes as a result of aerobic exercise

tranquilizers:

central nervous system depressants that relax the body and calm anxiety

trans fatty acid:

also trans fat, an artificial fat manufactured by chemically modifying monounsaturated and polyunsaturated fatty acids

Transtheoretical Model:

health behavior change starts with considering making a change followed by planning, implementing the plan, and overcoming

obstacles theory of reasoned action: change begins with an intention to adopt a new behavior and doing so is beneficial

traumatic brain injury (TBI):

injury caused by a bump, blow, or jolt to the head that results in impaired thinking or memory, altered movement or sensation, personality changes, or emotional problems such as depression

trichomoniasis:

vaginal infection caused by the protozoan *Trichomonas vaginalis*

triglyceride:

a storage form of fat

tubal ligation:

a surgical procedure in women in which the fallopian tubes are cut, tied, or cauterized to prevent pregnancy; a form of sterilization

tuberculosis (TB):

a serious lung infection caused by the bacterium *Mycobacterium tuberculosis*

tumor viruses:

viruses that infect cells, change their growth properties, and cause cancer

tumor:

a mass of abnormal cells

type 1 (insulin-dependent) diabetes:

when the pancreas is diseased and unable to manufacture the hormone insulin to regulate the level of sugar in the blood

type 2 (non-insulin-dependent) diabetes:

caused by too much fat in the blood (generally from being overweight), resulting in the body becoming resistant to the actions of insulin

typical user failure rate:

estimates how well a method performs when all of the errors and problems typically encountered with a method are taken into account

U

ultrasound scanning:

use of sound waves to visualize the fetus in the uterus

unintentional injury:

preferred term for accidental injury; result of an accident

universal donors:

people whose blood is accepted by everyone during transfusion

universal recipients:

people whose blood type is compatible with anyone else's blood

unsafe days:

days in the menstrual cycle when fertilizable ova are most likely to be produced

V

vaccination:

the administration, usually by injection (hence the name "shot"), of substances called vaccines

vaccines:

inactivated bacteria or viruses that are injected or taken orally; the body responds by producing antibodies and cells that

provide lasting immunity

varicose veins:

swelling of veins (usually in the legs) resulting from defective valves

vasectomy:

a surgical procedure in men in which segments of the vas deferens are removed and the ends tied to prevent the passage of sperm

vector:

the carrier of infectious organisms from animals to people or from person to person

vegetarian:

one who consumes no meat, poultry, or fish

veins:

blood vessels that return blood from tissues to the heart

ventricular fibrillation (“v-fib”):

irregular quivering of the lower chambers of the heart

violence:

a physical or verbal behavior in which the intent is to harm, injure, or destroy someone or something

virtual reality therapy (VRT):

use of computer programs to create virtual worlds that engage the mind in order to overcome pain and fear and to treat symptoms of posttraumatic stress disorder

vitamins:

essential organic substances needed daily in small amounts to perform specific functions in the body

vulvovaginitis:

vaginal irritation, often called a yeast infection

W

water-soluble vitamins:

soluble in water; there are nine water-soluble vitamins

well-being:

qualities of life that include positive emotions (e.g., happiness, contentment) and life satisfaction

wellness model:

encompasses the physiological, mental, emotional, social, spiritual, and environmental aspects of health

withdrawal:

uncomfortable and sometimes dangerous reactions that occur after a person stops taking a physically addicting drug

Y

yoga:

a system of exercises formulated in India thousands of years ago to unite one's mind and body



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- Zen meditation (zazen), 31

A table with the header Assessing Health Information. Things to keep in mind when getting information derived from health and medical research colon 1. What organization or individual is providing the information? What is the provider's stated or implied intention? Assessing the motives of information provided on the internet is especially important because a web site can be made to appear educational when, in fact, its goal is to influence attitudes and behaviors, including purchases. 2. What is the information provider's training and expertise? Popular magazine articles often quote scientists and doctors to support the article's thesis. Can you really be sure that the person being quoted is a reliable authority? What is the source of the data in the research? Is the information based on an observer's experience, a survey, or a study comparing a open inverted comma treatment close inverted comma group with a group of open inverted comma matched controls. close inverted comma 3. Who Benefits? What benefits is the source of the information receiving for communicating it. You want to avoid being manipulated by bias presented in the guise of scientific truth. Occasionally, a study's results are described as statistically significant, which means that an observation, or a comparison of observations, is highly likely not to be the result of mistakes made by researchers or to have occurred by chance. Findings are statistically significant if a mathematical analysis of the data show a very small hyphen or insignificant hyphen chance that the findings from this analysis are wrong. Scientists generally are willing to accept

a finding as true if the chance it is wrong is less than 1 in 20
open parenthesis reported as p equals 0.05 close
parenthesis.

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A bar graph of sales figures for 33 leading transnational corporations in 2017 by sector. The horizontal line represents food product category and the vertical axis represents world sales in US billion dollars, 2017: 100, 200, 300 and 400. Processed food is at 345 billion dollars while Tobacco and Alcohol is at 150 billion dollars. Soft drinks are at 100 billion dollars and Fast food is at 60 billion dollars.

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A table of the components of health and well being. There are two columns: Category and Description. Row: 1. Category: Mental and physical health. Description: Self rated degree of physical and mental health. Row: 2. Category: Financial status. Description: Self-rated concern about being able to meet normal living expenses. Row: 3. Category: Happiness. Description: Self-rated degree of current satisfaction with life and self-rated usual sense of happiness or unhappiness. Row: 4. Category: Meaning & purpose in life. Description: Self-rated extent that life activities are worthwhile. I know my purpose in life. Row: 5. Category: Close personal relationships. Description: Contentment and satisfaction with current relationships and friendships. Row:

6. Category: Character. Description: Strive to promote good in all, even challenging, situations. Willingness to forego some happiness in the present for greater happiness in the future.

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A table of scientific measures of health status. There are two columns: Measuring method and What is measured. Row: 1. Measuring method: Years of potential life lost. What is measured: Total number of years not lived by people who die for whatever reason before reaching a given age. Row: 2. Measuring method: Disability Adjusted Life Years. What is measured: Total number of years lived with illness or disease limits life in some way. Row: 3. Measuring method: Physically and Mentally Unhealthy Days. What is measured: Reported for the prior 60 days. Row: 4. Measuring method: Chronic Disease Prevalence. What is measured: Reported for either cardiovascular disease, arthritis, diabetes, asthma, cancer, and chronic obstructive pulmonary disease. Row: 5. Measuring method: Limitation of Activity. What is measured: Due to physical, mental, or emotional problems. Row: 6. Measuring method: Self-assessed Health Status. What is measured: Individual perception of his or her health rated as excellent, very good, good, fair, or poor. Row: 7. Measuring method: Health Related Quality of Life. What is measured: An individual's or a group's perceived physical and mental health over time and the impact of preventable diseases, injuries, and disabilities on the quality of life.

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A table of health care quality comparisons among high income countries. There are two columns: Health measures and US Rank. Row: 1. Health measure: Life expectancy from birth in years. US Rank: 12th. Row: 2. Health measure: Maternal Mortality percentage per 100,000. US Rank: 12th. Row: 3. Health measure: Infant Mortality percentage per 1000 live births. US Rank: 12th. Row: 4. Health measure: Mortality rate in deaths per year per 100000 population. US Rank: 12th. Row: 5. Health measure: Premature Deaths Years of Potential Life Lost. US Rank: 12th. Row: 6. Health measure: Years Living with Disease Disability Adjusted Life Years. US Rank: 12th. Row: 7. Health measure: Doctors per 1000 population. US Rank: 11th. Row: 8. Health measure: Spending on Pharmaceuticals & Medical Devices. US Rank: 1st. Row: 9. Health measure: Percent with some health insurance. US Rank: 12th. Row: 10. Health measure: Daily smokers. US Rank: 12th. Row: 11. Health measure: Death rate for poor mental health and substance abuse. US Rank: 1st. Row: 12. Health measure: Alcohol consumption liters per person per year. US Rank: 5th. Row: 13. Health measure: Percent with Alcohol Abuse Disorder. US Rank: 2nd. Row: 14. Health measure: Opioid deaths per 1 million inhabitants in 2018. US Rank: 1st. Row: 15. Health measure: Percent overweight per obese. US Rank: 1st. Row: 16. Health measure: Percent overweight children. US Rank: 1st. Row: 17. Health measure: Air pollution deaths per year. US Rank: 3rd. Row: 18. Health measure: Heart Disease mortality per

100,000 persons. US Rank: 1st. Row: 19. Health measure: Stroke mortality per 100,000 persons. US Rank: 7th. Row: 20. Health measure: Cancer incidence per 100,000 persons. US Rank: 2nd. Row: 21. Health measure: Cancer mortality per 100,000 persons. US Rank: 5th. Row: 22. Health measure: Diabetes prevalence per 100,000 persons. US Rank: 1st. Row: 23. Health measure: Suicide per 100,000 persons. US Rank: 2nd. Row: 24. Health measure: Self-rated health percentage bad or very bad. US Rank: 12th. Row: 24. Health measure: Self-rated health percentage good or very good. US Rank: 2nd.

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A bar graph depicting healthcare cost comparison among high income countries. The horizontal axis represents amount in US dollars. The vertical axis represents Rank by countries. United States is the highest at 10586 dollars. Next is Switzerland at 7317 dollars. Norway is at 6187 dollars and Germany is at 5986 dollars. Netherlands is at 5288 dollars and Australia is at 5005 dollars. Canada is at 4974 dollars and France is close behind at 4965 dollars. Japan is at 4766 dollars and United Kingdom is at 4070 dollars. Italy is at 3428 dollars and Spain is at 3323 dollars. Greece is at 2238 dollars and Mexico is at 1138 dollars. The O E C D average is at 3994 dollars.

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A table of cost comparison of some prescription drugs. There are two main columns: Drug and Cost in dollars. Cost has four sub columns: United States, Canada, India and United Kingdom, Australia and New Zealand. Row: 1. Drug: Celebrex 200 milligrams. Cost in United States: 13.72 dollars. Cost in Canada: 1.91 dollars. Cost in India: 1.05 dollars. Cost in United Kingdom, Australia and New Zealand: 0 dollars. Row: 2. Drug: Paxil 20 milligrams. Cost in United States: 6.83 dollars. Cost in Canada: 2.98 dollars. Cost in India: 0.98 dollars. Cost in United Kingdom, Australia and New Zealand: 0 dollars. Row: 3. Drug: Nexium 40 milligrams. Cost in United States: 7.78 dollars. Cost in Canada: 3.37 dollars. Cost in India: 0.35 dollars. Cost in United Kingdom, Australia and New Zealand: 2.21 dollars. Row: 4. Drug: Viagra 100 milligrams. Cost in United States: 58.72 dollars. Cost in Canada: 10.77 dollars. Cost in India: 4.44 dollars. Cost in United Kingdom, Australia and New Zealand: 8.31 dollars. Row: 5. Drug: Nasonex 50 micrograms. Cost in United States: 648.00 dollars. Cost in Canada: 132.53 dollars. Cost in India: 50.00 dollars. Cost in United Kingdom, Australia and New Zealand: 113.92 dollars.

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A table of the effects of income inequality on health measures of U S adults in 2018 in percentages. There are two main columns: Health measure and Income level. Income level has three sub columns: Low, Medium, High. Row: 1. Health measure: Inefficient exercise. Income level

low: 53.5. Income level medium: 43.2. Income level high: 32.0. Row: 2. Health measure: Limitation from chronic diseases. Income level low: 24.3. Income level medium: 12.4. Income level high: 7.1. Row: 3. Health measure: Self-rated poor health status. Income level low: 22.9. Income level medium: 11.2. Income level high: 5.0. Row: 4. Health measure: Current cigarette smoker. Income level low: 22.3. Income level medium: 14.0. Income level high: 7.1. Row: 5. Health measure: No health insurance. Income level low: 20.2. Income level medium: 11.5. Income level high: 4.2. Row: 6. Health measure: Nervous or distressed. Income level low: 18.8. Income level medium: 9.2. Income level high: 1.6. Row: 7. Health measure: Sad, hopeless, worthless depressed. Income level low: 15.8. Income level medium: 7.4. Income level high: 2.3. Row: 9. Health measure: Emphysema or bronchitis. Income level low: 8.0. Income level medium: 4.8. Income level high: 2.8.

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An illustration of a man's body depicting functions controlled by the automatic nervous system. The sympathetic and parasympathetic functions have been listed. The man's trachea, lungs, heart, stomach, liver, kidney and reproductive system have been depicted. To the left are the sympathetic functions: 1. Dilates pupils. 2. Inhibits salivation. 3. Dilates bronchi, lungs. 4. Stimulates heartbeat. 5. Stimulates adrenal gland. 6. Inhibits digestion in the stomach, pancreas, liver and spleen. 7. Dilates bladder. To the right are the

parasympathetic functions: 1. Constricts pupils. 2. Stimulates salivation. 3. Constricts bronchi, lungs, 4. Slows heartbeat. 5. Inhibits adrenal gland. 6. Stimulates digestion in stomach, pancreas, liver and spleen. 7. Contracts bladder.

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A set of illustrations depicting where hormones are released. There is an illustration of a man to the left and a woman to the right. In both illustrations, the following hormones are depicting. Within the brain are the hypothalamus at the forehead and the pituitary is just above the nose at the center of the forehead. The thyroid, or ventral, is a w-shaped formation at the throat while the parathyroids or dorsal are just below the thyroids within the w-shape. The adrenals are small, triangular-shaped glands located on top of both kidneys while the pancreas are located behind the stomach in the upper left abdomen. The ovary is in the woman's pelvis while the testis are in the man's pelvis.

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A graph of the comparison of antidepressant medications and placebo in improvement of symptoms of mild and moderate depression. The horizontal axis represents the medication while the vertical axis represents improvement score from 1 to 14. The two factors measured are the drug and placebo. The first is Fluoxetine which measured an improvement score of 11 with 76 percent placebo. The

second is Venlafaxine which measured an improvement score of 11.5 with 60 percent placebo. The third is Nefazodone which measured an improvement score of 12 with 67 percent placebo. The fourth is Paroxetine which measured an improvement score of 12.5 with 55 percent placebo.

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An illustration of psychosomatic illnesses. A woman's body is depicted with the brain, larynx, lungs, heart, spinal cord, bones in the left hand, large intestine and reproductive system. Tension headaches occur in the brain while Bruxism, which is grinding of the teeth, occurs in the jaws. Tinnitus, ringing in one or both ears, occurs in the ear. Acne builds up on the face. Hyperactive thyroid occurs near the neck. Bronchial asthma occurs in the lungs. Back pain takes place in the back. Essential hypertension occurs at the heart. Ulcerative colitis occurs in the abdomen. Erection problems in men and menstrual problems in women occur in the reproductive system. Eczema occurs on the skin. Irritable bowel syndrome occurs in the bowels and Rheumatoid arthritis occurs in the bones.

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An illustration of biofeedback depicting the upper torso of a man turned to his right. There is a machine to his right with buttons and a sound waves emitting from it. The visual

display on the machine has squiggly lines on it. There are wires from the machine that are connected to his head.

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A painting of the mandala. It shows a figure in the middle, covered in flowers and striking a pose while seated cross-legged. A circle is formed behind the figure. At the bottom is land with water at the ends. Behind the circle are hills and the sky.

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A diagram of the components of stress. There are four text boxes with the first connected to the second, the second connected to the third and the third connected to the fourth. Box 1: Environmental component Stressors: War, Natural disaster, Major life events, Daily hassles, Family or relationship problems, Demanding job, Sexual abuse, Assault, Personal or family illness, Chronic anxiety, Major depression. Box 2: Mental component: My well-being is threatened and I'm not sure I have the personal, financial, and social resources to make things turn out OK. Box: 3. Emotional component: Fear, Anxiety, Frustration, Hopelessness, Depression. Box 4: Physiological component: Increase in heart rate, Increase in blood pressure, Changes in metabolism, Changes in alertness, Changes in sleep, Changes in immune function.

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An illustration depicting the Hypothalamo–Pituitary–Adrenal Axis. The illustration is of a boy clenching his fists with his head turned to his left. There is an illustration of the brain and the adrenal glands. The brain is labeled with another dotted arrow pointing that reads: Stressful thought. The Hypothalamus is labeled at the center of the brain with another dotted arrow pointing that reads: Release of C R F. The Pituitary gland is labeled at the bottom right of the brain with another dotted arrow pointing that reads: Release of A C T H. The adrenal glands, located behind the abdominal organs, is labelled at the abdomen with another dotted arrow pointing that reads: Release of cortisol. The words labeled by the dotted lines are connected to each other by arrows, from top to bottom.

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A diagram of the stress-illness relationship. The word stress is written in the middle. From the word, there is an arrow leading to the left to the words: Mind-body damage. From here, there is an arrow leading to the following pointers: 1. Gastrointestinal disorders: Constipation, Diarrhea, Duodenal ulcer, Ulcerative colitis. 2. Respiratory disorders: Asthma, Hay fever, Tuberculosis, Colds, Flu. 3. Skin disorders: Eczema, Pruritus, Urticaria, Psoriasis. 4. Eating disorders. 5. Depression. 6. Sleep problems. 7. Musculoskeletal disorders: Rheumatoid arthritis, Low back pain, Migraine headache, Muscle tension. 8. Metabolic disorders: Hyperthyroidism, Hypothyroidism, Diabetes, Overweight, Metabolic syndrome.

9. Cardiovascular disorders: Coronary artery disease, Essential hypertension, Congestive heart failure. 10. Menstrual irregularities. 11. Cancer. 12. Accident proneness. An arrow pointing down from stress leads to the words: Changes in the immune system. From here, an arrow leads to the following pointers: 1. Suppression of T- and B-cell functions. 2. Decreased interferon synthesis. 3. Decreased macrophage function. 4. Increased susceptibility to infections. 5. Weak response to vaccination. 6. Increased susceptibility to heart and blood vessel diseases. From the word stress, an arrow leads to the right to the words: Unhealthy behaviors. From here, an arrow leads to the following pointers: 1. Cigarette smoking. 2. Alcohol abuse. 3. Drug abuse. 4. Poor diet. 5. Violent behavior. 6. Decreased exercise.

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A chart of the general adaptation syndrome. A rectangle has been divided into three columns and two rows. The first column is titled Stage of alarm, the second is titled Stage of resistance, the third is titled Stage of exhaustion. The line moving horizontally and dividing the chart is titled: Normal level of resistance. There is a line that begins in the Stage of alarm column, at the middle line, and it drops before rising up to the Stage of resistance. The line plateaus through this stage and begins to drop in the Stage of exhaustion.

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A line graph of the kneeling curve. The horizontal axis represents years from 1960 to 2020, after every 5 years. The vertical axis represents carbon dioxide concentration from 310 to 420, after every 10. The line begins in 1960 at approximately 315 p p m. From here, it begins to gradually rise up, touching approximately 330 p p m in 1980, 350 p p m in 1990 and 380 p p m in 2005. The line ends at approximately 420 p p m in 2020.

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A chart prioritizing tasks. To the left is a square box with the following text: To-do - Call Jeremy, Poli sci quiz, Chem problem set, Mom birthday card, Send Monica email, Download music, Prof. Adams office hour, New shoes. The second square has text which reads as follows: To the top is the word Important. Below that are two columns: Yes and No. To the left is the word Urgent. Beside that are two rows: Yes and No. Important and Urgent Yes tasks are Poli sci quiz, Mom birthday card and Prof Adams. Yes to urgent and No to important task is Call Jeremy. Yes to important and No to urgent task is Send Monica email and Chem problem set. No to important and urgent task is Download music and New shoes.

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A diagram of performance affected by anxiety and arousal. There is a graph. The horizontal axis represents anxiety from

low to high. The vertical axis represents task performance from low to high. There is a line which moves across the graph in a semi circle formation. The area towards low anxiety and between low and high task performance is where performance increases as arousal increases. The area towards high task performance and between low and high anxiety is where it is at optimal performance. The area towards high anxiety and high task performance is where decreasing performance due to increasing arousal takes place.

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A bar chart depicting strength of immune response. There is a graph. The horizontal axis represents No support and With support. The vertical axis represents strength of immune response. The three factors measured are final exams, loneliness and spouse has cancer. In the no support category, final exams is at the highest followed by spouse has cancer and the lowest being loneliness. In the with support category, final exams is at the highest followed by loneliness and finally spouse has cancer.

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A diagram of the basic human emotions. There is a flower formation with 8 petals. Between the flower are three circles of different sizes, dividing every petal into four sections. Petal 1's innermost layer reads: Admiration. Second layer reads:

Trust. Third layer reads: Acceptance. Petal 2's innermost layer reads: Terror. Second layer reads: Fear. Third layer reads: Apprehension. The word - Submission - is placed between both petals. Petal 3's innermost layer reads: Amazement. Second layer reads: Surprise. Third layer reads: Distraction. The word - Awe - is placed between both petals. Petal 4's innermost layer reads: Grief. Second layer reads: Sadness. Third layer reads: Pensiveness. The word - Disapproval - is placed between both petals. The word - Remorse - is placed between both petals. Petal 5's innermost layer reads: Loathing. Second layer reads: Disgust. Third layer reads: Boredom. The word - Contempt - is placed between both petals. Petal 6's innermost layer reads: Rage. Second layer reads: Anger. Third layer reads: Annoyance. The word - Aggressiveness - is placed between both petals. Petal 7's innermost layer reads: Vigilance. Second layer reads: Anticipation. Third layer reads: Interest. The word - Optimism - is placed between both petals. Petal 8's innermost layer reads: Ecstasy. Second layer reads: Joy. Third layer reads: Serenity. The word - Love - is placed between both petals.

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A line graph of the human sleep cycle. The horizontal axis represents elapsed hours of sleep from 0 to 7. The vertical axis represents stage of sleep, from stage 1 to 4 and Awake. The factors measured are R E M. The area between stage 1 and awake is R E M. The line begins at awake, and goes

down to stage 4 between 0-1 hours of sleep. The line goes back up between stage 1 and awake between 1-2 hours of sleep at R E M. The line goes back below to stage 4 and comes up to stage 2 at 2 hours of sleep. The line goes back down to stage 4, come back to stage 2, goes back down to stage 4 and goes right up to R E M between 2-3 hours of sleep. From here, the line drop down to stage 2 and 3 alternatively with R E M. At 6 hours of sleep, it hits awake before going back down to stage 2, then R E M, before ending at stage 2.

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A table of healthy eating pattern. Recommended intake amounts in U. S. There are two main columns: Food group and Calorie level of pattern. There are three sub columns under calorie level of pattern: 1600, 2000 and 2400. Food group: Vegetables. Calorie level of pattern 1600: 2 cup equivalent. Calorie level of pattern 2000: 2 and half cup equivalent. Calorie level of pattern 2400: 3 cup equivalent. Row: 2. Food group: Dark-green vegetables cup equivalent per week. Calorie level of pattern 1600: 1 and half cup equivalent. Calorie level of pattern 2000: 1 and half cup equivalent. Calorie level of pattern 2400: 2 cup equivalent. Row: 3. Food group: Red and orange vegetables cup equivalent per week. Calorie level of pattern 1600: 4 cup equivalent. Calorie level of pattern 2000: 5 and half cup equivalent. Calorie level of pattern 2400: 6 cup equivalent. Row: 4. Food group: Legumes beans and peas cup

equivalent per week. Calorie level of pattern 1600: 1 cup equivalent. Calorie level of pattern 2000: 1 and half cup equivalent. Calorie level of pattern 2400: 2 cup equivalent.

Row: 5. Food group: Starchy vegetables cup equivalent per week. Calorie level of pattern 1600: 4 cup equivalent. Calorie level of pattern 2000: 5 cup equivalent. Calorie level of pattern 2400: 6 cup equivalent.

Row: 6. Food group: Other vegetables cup equivalent per week. Calorie level of pattern 1600: 3 and half cup equivalent. Calorie level of pattern 2000: 4 and half cup equivalent. Calorie level of pattern 2400: 5 cup equivalent.

Row: 7. Food group: Fruits. Calorie level of pattern 1600: 1 and half cup equivalent. Calorie level of pattern 2000: 2 cup equivalent. Calorie level of pattern 2400: 2 cup equivalent.

Row: 8. Food group: Grains. Calorie level of pattern 1600: 5 ounce equivalent. Calorie level of pattern 2000: 6 ounce equivalent. Calorie level of pattern 2400: 8 ounce equivalent.

Row: 9. Food group: Whole grains ounce equivalent per day. Calorie level of pattern 1600: 3 ounce equivalent. Calorie level of pattern 2000: 3 ounce equivalent. Calorie level of pattern 2400: 4 ounce equivalent.

Row: 10. Food group: Refined grains ounce equivalent per day. Calorie level of pattern 1600: 2 ounce equivalent. Calorie level of pattern 2000: 3 ounce equivalent. Calorie level of pattern 2400: 4 ounce equivalent.

Row: 11. Food group: Dairy. Calorie level of pattern 1600: 3 cup equivalent. Calorie level of pattern 2000: 3 cup equivalent. Calorie level of pattern 2400: 3 cup equivalent.

Row: 12. Food group: Protein food. Calorie level of pattern 1600: 5 ounce

equivalent. Calorie level of pattern 2000: 5 and half ounce equivalent. Calorie level of pattern 2400: 6 and half ounce equivalent. Row: 13. Food group: Seafood ounce equivalent per week. Calorie level of pattern 1600: 8 ounce equivalent. Calorie level of pattern 2000: 8 and half ounce equivalent. Calorie level of pattern 2400: 10 ounce equivalent.

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Row: 14. Food group: Meats, poultry, eggs ounce equivalent per week. Calorie level of pattern 1600: 23 ounce equivalent. Calorie level of pattern 2000: 26 ounce equivalent. Calorie level of pattern 2400: 31 ounce equivalent. Row: 15. Food group: Nuts, seeds, soy products in ounce equivalent per week. Calorie level of pattern 1600: 4 ounce equivalent. Calorie level of pattern 2000: 5 ounce equivalent. Calorie level of pattern 2400: 5 ounce equivalent. Row: 16. Food group: Oils. Calorie level of pattern 1600: 22 grams. Calorie level of pattern 2000: 27 grams. Calorie level of pattern 2400: 31 grams. Row: 17. Food group: Limit on Calories for Other Uses in percent of calories. Calorie level of pattern 1600: 130 or 8 percent. Calorie level of pattern 2000: 270 or 14 percent. Calorie level of pattern 2400: 350 or 15 percent.

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A graph of dietary intakes compared to recommendations. The horizontal axis represents percent of population below recommendation or limit, to the left, and percent of

population at or above recommendation or limit, to the right. Both are depicted from 0 to 100, in multiples of 20. The vertical axis represents food group or dietary component. The factors measured as intake below recommendation or above limit and intake at or above recommendation or below limit. Vegetables intake below recommendation or above limit is at approximately 90 percent of population below recommendation limit. Vegetables intake at or above recommendation or below limit is approximately 10 percent of population at or above recommendation or limit. Fruit intake below recommendation or above limit is at approximately 80 percent of population below recommendation limit. Fruit intake at or above recommendation or below limit is approximately 30 percent of population at or above recommendation or limit. Total grains intake below recommendation or above limit is at approximately 50 percent of population below recommendation limit. Total grains intake at or above recommendation or below limit is approximately 60 percent of population at or above recommendation or limit. Dairy intake below recommendation or above limit is at approximately 90 percent of population below recommendation limit. Dairy intake at or above recommendation or below limit is approximately 10 percent of population at or above recommendation or limit. Protein foods intake below recommendation or above limit is at approximately 40 percent of population below recommendation limit. Protein foods intake at or above

recommendation or below limit is approximately 60 percent of population at or above recommendation or limit. Oils intake below recommendation or above limit is at approximately 75 percent of population below recommendation limit. Oils intake at or above recommendation or below limit is approximately 30 percent of population at or above recommendation or limit. Oils intake below recommendation or above limit is at approximately 75 percent of population below recommendation limit. Oils intake at or above recommendation or below limit is approximately 30 percent of population at or above recommendation or limit. Added sugars intake at or above recommendation or below limit is approximately 30 percent of population below recommendation limit. Added sugars intake below recommendation or above limit is at approximately 70 percent of population at or above recommendation or limit. Saturated fats intake at or above recommendation or below limit is approximately 30 percent of population below recommendation limit. Saturated fats intake below recommendation or above limit is at approximately 70 percent of population at or above recommendation or limit. Sodium intake intake at or above recommendation or below limit is approximately 10 percent of population below recommendation limit. Sodium intake below recommendation or above limit is at approximately 90 percent of population at or above recommendation or limit.

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A diagram of the MyPlate. There is an illustration of a plate divided into four grids. The top left reads fruits, top right reads grains, bottom left reads vegetables and bottom right reads protein. There is a smaller circle to the top right with the word dairy written on it. There is a fork to the left. The words: choose my plate dot gov is written below.

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A table is depicted. There are five columns: Food group, Daily servings except as noted, Serving sizes, Examples and notes, Significance of each food group to the D A S H eating plan. Row: 1. Food group: Grains and grain products. Daily servings: 6-8. Serving sizes: 1 slice bread, 1 ounce dry cereal, half cup cooked rice, pasta, or cereal. Examples and notes: Whole-wheat bread, English muffin, pita bread, bagel, cereals, grits, oatmeal, crackers, unsalted pretzels, and popcorn. Significance of each food group to the D A S H eating plan: Major sources of energy and fiber. Row: 2. Food group: Vegetables. Daily servings: 4-5. Serving sizes: 1 cup raw leafy, vegetable, half cup cooked vegetable, 6 ounce vegetable juice. Examples and notes: Tomatoes, potatoes, carrots, green peas, squash, broccoli, turnip greens, collards, kale, spinach, artichokes, green beans, lima beans, sweet potatoes. Significance of each food group to the D A S H eating plan: Rich sources of potassium, magnesium, and fiber. Row: 3. Food group: Fruits. Daily servings: 4-5. Serving sizes: 4 ounce fruit juice, 1 medium fruit, quarter cup dried fruit, half cup fresh, frozen, or canned fruit. Examples and

notes: Apricots, bananas, dates, grapes, oranges, orange juice, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, prunes, raisins, strawberries, tangerines.

Significance of each food group to the D A S H eating plan:

Important sources of potassium, magnesium, and fiber. Row:

4. Food group: Low-fat or fat-free dairy foods. Daily servings: 2-3. Serving sizes: 8 ounce milk, 1 cup yogurt, 1 and half ounce cheese. Examples and notes: Fat-free skim or low-fat 1 percent milk, fat-free or low-fat buttermilk, fat-free or low-fat regular or frozen yogurt, low-fat and fat-free cheese.

Significance of each food group to the D A S H eating plan:

Major sources of calcium and protein. Row: 5. Food group:

Lean meats, poultry, and fish. Daily servings: 6 or less.

Serving sizes: 3 ounce cooked meats, poultry, or fish.

Examples and notes: Select only lean; trim away visible fats; broil, roast, or boil instead of frying; remove skin from poultry. Significance of each food group to the D A S H eating plan: Rich sources of protein or magnesium.

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Row: 6. Food group: Nuts, seeds, and dry beans. Daily servings: 4-5 per week. Serving sizes: Half cup or 1 and half cup nuts. 1 Tablespoon or half ounce seeds. Half cup cooked dry beans, peas. Examples and notes: Almonds, filberts, mixed nuts, walnuts, sunflower seeds, kidney beans, lentils. Significance of each food group to the D A S H eating plan: Rich sources of energy, magnesium, potassium, protein, and fiber. Row: 7. Food group: Fats and oils. Daily servings: 2-3.

Serving sizes: 1 teaspoon soft margarine. 1 Tablespoon low-fat mayonnaise, 2 Tablespoon light salad dressing. 1 teaspoon vegetable oil. Examples and notes: Soft margarine, low-fat mayonnaise, light salad dressing, vegetable oil such as olive, corn, canola, or safflower. Significance of each food group to the D A S H eating plan: D A S H has 27 percent of calories as fat, including fat in or added to foods. Row: 8. Food group: Sweets. Daily servings: 5 per week. Serving sizes: 1 tablespoon sugar. 1 Tablespoon jelly or jam. Half ounce jellybeans. 8 ounce lemonade. Examples and notes: Maple syrup, sugar, jelly, jam, fruit-flavored gelatin, jellybeans, hard candy, fruit punch, sorbet, ices. Significance of each food group to the D A S H eating plan: Sweets should be low in fat. Row: 9. Food group: Maximum sodium limit. Daily servings: 2300 milligrams per day.

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A table of nutrition facts. The title is: Nutrition Facts. Below that is the serving size 1 package. There is a text co-relating to this which reads: Serving size is based on the amount of food that is customarily eaten at one time. All of the nutrition information listed on the nutrition facts label is based on one serving of the food. When comparing calories and nutrients in different foods, check the serving size in order to make an accurate comparison. Next line reads: Servings per container 1. There is a text co-relating to this that reads: Servings per container shows the total number of servings in the entire food package or container. One package of food may contain

more than one serving. If a package contains two servings and you eat the entire package, you have consumed twice the amount of calories and nutrients listed on the label. In the next row are the calories. There is a text co-relating to this which reads: Calories refers to the total number of calories, or energy, supplied from all sources like fat, carbohydrate, protein, and alcohol in one serving of the food. To achieve or maintain a healthy weight, balance the number of calories you consume with the number of calories your body uses. There is a small text box under this text which reads: As a general rule: 100 calories per serving is moderate. 400 calories per serving is high. Next to calories, on the label, is calories from fat. There is a text co-relating to this which reads: Calories from fat are not additional calories, but are fat's contribution to the total number of calories in one serving of the food. Fat-free doesn't mean calorie-free. Some lower fat food items may have as many calories as the full-fat versions. On the label, below calories from fat, is the percent daily value. There is a text co-relating to this which reads: Percent daily value shows how much of nutrient is in one serving of the food. The percent daily value column doesn't add up vertically to 100 percent. Instead, the percent daily value is the percentage of the daily value the amounts of key nutrients recommended per day for Americans 4 years of age and older for each nutrient in one serving of the food. There is a text box below this text which reads: As a general rule: 5 percent D V or less of a nutrient per serving is low. 20 percent D V or more of a nutrient per serving is high. Next,

on the label, total fat in saturated fat and trans fat, cholesterol, sodium, total carbohydrates, dietary fibers, sugars, protein, vitamin A, vitamin C, calcium and iron.

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There is a text co-relating to this which reads: The nutrition facts label can help you learn about and compare the nutrient content of many foods in your diet. Use it to choose products that are lower in nutrients you want to get less of and higher in nutrients you want to get more of. There is a text box below this text which reads: Nutrients to get less of - get less than 100 percent D V of these nutrients each day: saturated fat, trans fat, cholesterol, and sodium. Note: trans fat has no percentage D V, so use the amount of grams as guide. There is another text box below which reads: Nutrients to get more of - get 100 percent D V of these nutrients on most days: dietary fiber, vitamin A, vitamin C, calcium, and iron. On the label, below the nutrients, is a text which reads: Percent daily values are based on 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs. There is a text co-relating to this which reads: Some of the percent D Vs are based on a 2,000 calorie daily diet. However, your daily values may be higher or lower depending on your calorie needs, which vary according to age, gender, height, weight, and physical activity level. Check your calorie needs at [www choosemyplate got gov](http://www.choosemyplate.gov). If there is enough space available on the food package, the daily values and

goals for some key nutrients are given for both a 2,000 and 2,500 calorie daily diet.

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A diagram depicting what a serving is. There are four columns. Column 1: Grain products. 1 serving looks like: 1. 1 cup of cereal flakes equal to fist. There is an illustration of a fist. 2. 1 pancake equal to compact disc. There is an illustration of a compact disc. 3. Half cup of cooked rice, pasta, or potato equal to half baseball. There is an illustration of half a baseball. 4. 1 slice of bread equal to passport. There is an illustration of a passport. 5. 1 piece of cornbread equal to bar of soap. There is illustration of a soap. Column 2: Vegetables and fruit. 1 serving looks like: 1. 1 cup of salad greens equal baseball. There is an illustration of a baseball. 2. 1 baked potato equal fist. There is an illustration of a hand making a fist. 3. 1 medium fruit equal to baseball. 4. Half cup of fresh fruit equal to half baseball. There is an illustration of half a baseball. 4. Quarter cup of raisins equal to large egg. There is an illustration of an egg cracked in half. Column 3: Dairy and cheese. 1 serving looks like. 1. 1 and half ounce cheese equal to 4 stacked dice or 2 cheese slices. There is an illustration of four dice stacked together. 2. Half cup of ice cream equal to half baseball. There is an illustration of half baseball. 3. 1 teaspoon margarine or spreads equal to 1 dice. Column 4: Meat and alternatives. 1. 3 ounce meat, fish, and poultry is equal to a deck of cards. There is an illustration of two playing cards. 2. 3 ounce grilled or baked

fish equal to a checkbook. There is an illustration of a checkbook leaf. 3. 2 tablespoon peanut butter equal to a ping pong ball. There is an illustration of a ping pong ball.

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A chart detailed how to reduce food waste. There is a text box in the middle that reads: How to reduce waste. Around this are 6 text boxes, each placed around in a circular formation. There is an arrow connecting each of the outer 6 boxes in a circular formation. Text box 1 reads: Plan ahead. Text box 2 reads: Buy what you need. Text box 3 reads: Store correctly. Text box 4 reads: Cook the right amount. Text box 5 reads: Eat it all or store leftovers for later. Text box 6 reads: Recycle what you can't eat.

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A table of essential nutrients. There are five columns: Amino acids, fats, water, vitamins, minerals. Amino acids are: 1. Isoleucine. 2. Leucine. 3. Lysine. 4. Methionine. 5. Phenylalanine. 6. Threonine. 7. Tryptophan. 8. Valine. 9. Arginine. 10. Histidine. Fats are: 1. Linoleic acid. 2. Linolenic acid. Vitamins are: 1. Ascorbic acid, vitamin C. 2. Biotin. 3. Cobalamin, vitamin B12. 4. Folic acid. 5. Niacin, Vitamin B3. 6. Pantothenic acid. 7. Pyridoxine, vitamin B6. 8. Riboflavin, vitamin B2. 9. Thiamine, vitamin B1. 10. Vitamin A. 11. Vitamin D. 12. Vitamin E. 13. Vitamin K. Minerals are: 1. Calcium. 2. Chlorine. 3. Chromium. 4. Cobalt. 5. Copper. 6.

Iodine. 7. Iron. 8. Magnesium. 9. Manganese. 10. Molybdenum. 11. Phosphorus. 12. Potassium. 13. Selenium. 14. Sodium. 15. Sulfur. 16. Zinc.

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An illustration of human digestive system. A woman's body is depicted. To the top is her oral cavity, towards her mouth. The Esophagus is in the chest. The Liver is below the chest. The Stomach is below the liver. The Pancreas are below the stomach. The Transverse colon is by the large intestine. The Jejunum and Ileum are within the small intestine. The Colon is by the large intestine. The Rectum is by the pelvis and the Anus is at the tip of the pelvis.

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An illustration of two teeth. There is an M-shaped formation above which is the tooth that is visible on the outside, known as the enamel. Between the two teeth is a lodged object which is plaque helping bacterial attack. In the middle of the M-formation, just below the outer tooth, is the pulp cavity. The two elongated portions of the M-formation contain the nerves. On the outer tooth is a chipped section which is the breach in the enamel. Above the pulp cavity and below the breach is where the caries attack the dentine.

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A list of names for sugars added to commercial foods. The list is as follows: Agave nectar Barbados sugar Barley malt Barley malt syrup Beet sugar Brown sugar Buttered syrup Cane juice Cane juice crystals Cane sugar Caramel Carob syrup Caster sugar Coconut palm sugar Coconut sugar Confectioner's sugar Corn sweetener Corn syrup Corn syrup solids Date sugar Dehydrated cane juice Demerara sugar Dextrin Dextrose Fructose Fruit juice concentrate Glucose High-fructose corn syrup Honey Icing sugar Invert sugar Malt sugar Maltodextrin Maltol Maltose Mannose Maple syrup Molasses Muscovado Palm sugar Panocha Powdered sugar Raw sugar Refiner's syrup Rice syrup Saccharose Sorghum syrup Sucrose Sugar granulated Sweet sorghum Syrup Treacle Turbinado sugar Yellow sugar

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A table of water soluble and fat soluble vitamins. There are four columns: Water soluble vitamin, Why needed, Primary sources, Deficiency results in. Row: 1. Water soluble vitamin: Ascorbic acid vitamin C. Why needed: Tooth and bone formation; production of connective tissue; promotion of wound healing; may enhance immunity. Primary sources: Citrus fruits, tomatoes, peppers, cabbage, potatoes, melons. Deficiency results in: Scurvy, degeneration of bones, teeth, and gums. Row: 2. Water soluble vitamin: Biotin. Why needed: Involved in fat and amino acid synthesis and breakdown. Primary sources: Yeast, liver, milk, most vegetables, bananas, grapefruit. Deficiency results in: Skin

problems; fatigue; muscle pains; nausea. Row: 3. Water soluble vitamin: Cobalamin vitamin B12. Why needed: Involved in single carbon atom transfers; essential for D N A synthesis. Primary sources: Muscle meats, eggs, milk, and dairy products, not in vegetables. Deficiency results in: Pernicious anemia; nervous system malfunctions. Row: 4. Water soluble vitamin: Folacin folic acid. Why needed: Essential for synthesis of D N A and other molecules. Primary sources: Green leafy vegetables, organ meats, whole-wheat products. Deficiency results in: Anemia; diarrhea and other gastrointestinal problems. Row: 5. Water soluble vitamin: Niacin. Why needed: Involved in energy production and synthesis of cell molecules. Primary sources: Grains, meats, legumes. Deficiency results in: Pellagra, skin, gastrointestinal, and mental disorders. Row: 6. Water soluble vitamin: Pantothenic acid. Why needed: Involved in energy production and synthesis of cell molecules. Primary sources: Yeast, meats and fish, nearly all vegetables and fruits. Deficiency results in: Vomiting; abdominal cramps; malaise; insomnia. Row: 7. Water soluble vitamin: Pyridoxine vitamin B6. Why needed: Essential for synthesis and breakdown of amino acids and manufacture of unsaturated fats from saturated fats. Primary sources: Meats, whole grains, most vegetables. Deficiency results in: Weakness; irritability; trouble sleeping and walking; skin problems.

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Row: 8. Water soluble vitamin: Riboflavin vitamin B2. Why needed: Involved in energy production; important for health of the eyes. Primary sources: Milk and dairy foods, meats, eggs, vegetables, grains. Deficiency results in: Eye and skin problems. Row: 9. Water soluble vitamin: Thiamin vitamin B1. Why needed: Essential for breakdown of food molecules and production of energy. Primary sources: Meats, legumes, grains, some vegetables. Deficiency results in: Beri-beri nerve damage, weakness, heart failure. Row: 10. Water soluble vitamin: Fat-soluble vitamin. Why needed: Why needed? Primary sources: Primary sources. Deficiency results in: Deficiency or excess results in. Row: 11. Water soluble vitamin: Vitamin A retinol. Why needed: Essential for maintenance of eyes and skin; influences bone and tooth formation. Primary sources: Liver, kidney, yellow and green leafy vegetables, apricots. Deficiency results in: Deficiency: night blindness; eye damage; skin dryness. Excess: loss of appetite; skin problems; swelling of ankles and feet. Row: 12. Water soluble vitamin: Vitamin D calciferol. Why needed: Regulates calcium metabolism; important for growth of bones and teeth. Primary sources: Cod liver oil, dairy products, eggs. Deficiency results in: Deficiency: rickets, bone deformities in children; bone destruction in adults. Excess: thirst; nausea; weight loss; kidney damage. Row: 13. Water soluble vitamin: Vitamin E tocopherol. Why needed: Prevents damage to cells from oxidation; prevents red blood cell destruction. Primary sources: Wheat germ, vegetable oils, vegetables, egg yolk, nuts. Deficiency results in: Deficiency:

anemia, possibly nerve cell destruction. Row: 14. Water soluble vitamin: Vitamin K phylloquinone. Why needed: Helps with blood clotting. Primary sources: Liver, vegetable oils, green leafy vegetables, tomatoes. Deficiency results in: Deficiency: severe bleeding.

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A table of essential minerals. There are four columns: Mineral, Why needed, Primary sources, Deficiency results in.

Row: 1. Mineral: Calcium. Why needed: Bone and tooth formation; blood clotting; nerve transmission. Primary sources: Milk, cheese, dark-green vegetables, dried legumes. Deficiency results in: Stunted growth; rickets, osteoporosis; convulsions.

Row: 2. Mineral: Chlorine. Why needed: Formation of gastric juice; acid–base balance. Primary sources: Common salt. Deficiency results in: Muscle cramps; mental apathy; reduced appetite.

Row: 3. Mineral: Chromium. Why needed: Glucose and energy metabolism. Primary sources: Fats, vegetable oils, meats. Deficiency results in: Impaired ability to metabolize glucose.

Row: 4. Mineral: Cobalt. Why needed: Constituent of vitamin B12. Primary sources: Organ and muscle meats. Deficiency results in: Not reported in humans.

Row: 5. Mineral: Copper. Why needed: Constituent of enzymes of iron metabolism. Primary sources: Meats, drinking water. Deficiency results in: Anemia rare.

Row: 6. Mineral: Iodine. Why needed: Constituent of thyroid hormones. Primary sources: Marine fish and shellfish, dairy products, many vegetables.

Deficiency results in: Goiter, enlarged thyroid. Row: 7. Mineral: Iron. Why needed: Constituent of hemoglobin and enzymes of energy metabolism. Primary sources: Eggs, lean meats, legumes, whole grains, green leafy vegetables. Deficiency results in: Iron-deficiency anemia, weakness, reduced resistance to infection. Row: 8. Mineral: Magnesium. Why needed: Activates enzymes; involved in protein synthesis. Primary sources: Whole grains, green leafy vegetables. Deficiency results in: Growth failure; behavioral disturbances; weakness, spasms. Row: 9. Mineral: Manganese. Why needed: Constituent of enzymes involved in fat synthesis. Primary sources: Widely distributed in foods. Deficiency results in: In animals: disturbances of nervous system, reproductive abnormalities. Row: 10. Mineral: Molybdenum. Why needed: Constituent of some enzymes. Primary sources: Legumes, cereals, organ meats. Deficiency results in: Not reported in humans. Row: 11. Mineral: Phosphorus. Why needed: Bone and tooth formation; acid–base balance. Primary sources: Milk, cheese, meat, poultry, grains. Deficiency results in: Weakness; demineralization of bone. Row: 12. Mineral: Potassium. Why needed: Acid–base balance; body water balance; nerve function. Primary sources: Meats, milk, many fruits. Deficiency results in: Muscular weakness; paralysis. Row: 13. Mineral: Selenium. Why needed: Functions in close association with vitamin E. Primary sources: Seafood, meat, grains. Deficiency results in: Anemia, rare. Row: 14. Mineral: Sodium. Why needed: Acid–base balance; body water balance; nerve function.

Primary sources: Common salt. Deficiency results in: Muscle cramps; mental apathy; reduced appetite. Row: 15. Mineral: Sulfur. Why needed: Constituent of active tissue compounds, cartilage, and tendon. Primary sources: Sulfur amino acids methionine and cysteine in dietary proteins. Deficiency results in: Related to intake and deficiency of sulfur amino acids. Row: 16. Mineral: Zinc. Why needed: Constituent of enzymes involved in digestion. Primary sources: Widely distributed in foods. Deficiency results in: Growth failure.

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A table of some types of food additives. There are four columns: Type of additive, functions, common sources and common label names. Row: 1. Type of additive: Preservatives. Functions: Prevent or slow spoilage, changes in color, texture, flavor. Common sources: Jellies, baked goods, cured meats, snacks, cereals, sauces. Common label names: Ascorbic acid, citric acid, sodium benzoate, calcium propionate, sodium nitrite, calcium sorbate, B H A, B H T. Row: 2. Type of additive: Sweeteners. Functions: Add sweet taste. Common sources: Many processed foods, candy, baked goods, beverages. Common label names: Sucrose, high fructose corn syrup, corn syrup, aspartame, acesulfame, fructose. Row: 3. Type of additive: Colorings. Functions: Offset color loss because of light, air, temperature, moisture and storage; provide, correct and enhance natural color. Common sources: Candies, snack foods, pie fillings, cheese, puddings, soft drinks, jams or jellies. Common label names:

F D and C Blue Nos. 1 and 2, F D and C Green No. 3, F D and C Red Nos. 3 and 40, F D and C Yellow Nos. 5 and 6, Orange B, Citrus Red No. 2, annatto extract, beta-carotene, grape skin extract, cochineal extract or carmine, paprika oleoresin, caramel color, fruit and vegetable juices, saffron.

Row: 4. Type of additive: Flavorings. Functions: Spices, natural and artificial flavors. Common sources: Ice cream, pudding, cake mixes, salad dressing, soft drinks, candy, B B Q sauce. Common label names: Natural flavoring, artificial flavor, and spices.

Row: 5. Type of additive: Flavor enhancers. Functions: Enhance flavors already present without providing a separate flavor. Common sources: Many processed foods. Common label names: Monosodium glutamate, salt, autolyzed yeast extract.

Row: 6. Type of additive: Fat replacements. Functions: Provide expected texture and a creamy mouth-feel. Common sources: Baked goods, dressings, frozen desserts, candy, cake mixes, dairy products. Common label names: Cellulose gel, guar gum carrageenan, food starch, polydextrose, whey protein.

Row: 7. Type of additive: Emulsifiers. Functions: Prevent separation, reduce stickiness, smooth mixing of ingredients. Common sources: Salad dressings, peanut butter, chocolate, frozen desserts. Common label names: Soy lecithin, mono- and diglycerides, egg yolks, sorbitan monostearate.

Row: 8. Type of additive: Stabilizers, thickeners. Functions: Produce uniform texture, improve mouth feel. Common sources: Frozen desserts, sauces, dairy products, cakes, jams,

pudding, dressings. Common label names: Gelatin, pectin, guar gum, carrageenan, xanthan gum, whey.

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A table of pathogens that cause foodborne illness. There are four columns: Pathogen, Found, Transmission, Symptoms.

Row: 1. Pathogen: *Campylobacter jejuni*. Found: Intestinal tracts of animals and birds, raw milk, untreated water, and sewage sludge. Transmission: Contaminated water, raw milk, and raw or undercooked meat, poultry, or shellfish.

Symptoms: Fever, headache, and muscle pain followed by diarrhea, sometimes bloody, abdominal pain, and nausea.

Symptoms appear 2 to 5 days after eating; may last 7 to 10 days. Row: 2. Pathogen: *Clostridium botulinum*. Found:

Widely distributed in nature; in soil, water, on plants, and in intestinal tracts of animals and fish. Grows only in little or no oxygen..

Transmission: Bacteria produce a toxin that causes illness. Improperly canned foods, garlic in oil, vacuum-

packed and tightly wrapped food. Symptoms: Toxin affects

the nervous system. Symptoms usually appear 18 to 36 hours after eating but can sometimes appear as few as 4

hours or as many as 8 days after eating; double vision, droopy eyelids, trouble speaking and swallowing, and

difficulty breathing. Fatal in 3 to 10 days if not treated. Row:

3. Pathogen: *Clostridium perfringens*. Found: Soil, dust, sewage, and intestinal tracts of animals and humans. Grows only in little or no oxygen. Transmission: Called the cafeteria germ because many outbreaks result from food left for long

periods in steam tables or at room temperature. Bacteria destroyed by cooking, but some toxin-producing spores may survive. Symptoms: Diarrhea and gas pains may appear 8 to 24 hours after eating; usually last about 1 day, but less severe symptoms may persist for 1 to 2 weeks. Row: 4.

Pathogen: *Escherichia coli* O157:H7. Found: Intestinal tracts of some mammals, raw milk, unchlorinated water; one of several strains of *E. coli* that can cause human illness.

Transmission: Contaminated water, raw milk, raw or rare ground beef, unpasteurized apple juice or cider, uncooked fruits and vegetables; person to person. Symptoms: Diarrhea or bloody diarrhea, abdominal cramps, nausea, and malaise; can begin 2 to 5 days after food is eaten, lasting about 8 days. Some, especially the very young, have developed hemolytic-uremic syndrome, which causes acute kidney failure. A similar illness, thrombotic thrombocytopenic purpura, may occur in adults. Row: 5. Pathogen: *Listeria monocytogenes*. Found: Intestinal tracts of humans and animals, milk, soil, leafy vegetables; can grow slowly at refrigerator temperatures. Transmission: Ready-to-eat foods such as hot dogs, luncheon meats, cold cuts, fermented or dry sausage, and other deli-style meat and poultry, soft cheeses, and unpasteurized milk. Symptoms: Fever, chills, headache, backache, sometimes upset stomach, abdominal pain and diarrhea; may take up to 3 weeks to become ill; may later develop more serious illness in at-risk patients, pregnant women and newborns, older adults, and people with weakened immune systems. Row: 6. Pathogen:

Norovirus. Found: Human intestinal tract. Transmission: Person-to-person. Symptoms: Nausea, vomiting, diarrhea, resolving in 1 to 2 days.

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Row: 7. Pathogen: Salmonella more than 2,300 types. Found: Intestinal tracts and feces of animals; Salmonella enteritidis in eggs. Transmission: Raw or undercooked eggs, poultry, and meat; raw milk and dairy products; seafood; and food handlers. Symptoms: Stomach pain, diarrhea, nausea, chills, fever, and headache usually appear 8 to 72 hours after eating; may last 1 to 2 days. Row: 8. Pathogen: Shigella, more than 30 types. Found: Human intestinal tract; rarely found in other animals. Transmission: Person to person by fecal–oral route; fecal contamination of food and water. Most outbreaks result from food, especially salads, prepared and handled by workers using poor personal hygiene. Symptoms: Disease referred to as shigellosis or bacillary dysentery. Diarrhea containing blood and mucus, fever, abdominal cramps, chills, and vomiting; 12 to 50 hours from ingestion of bacteria; can last a few days to 2 weeks. Row: 9. Pathogen: Staphylococcus aureus. Found: On humans skin, infected cuts, pimples, noses, and throats. Transmission: Person to person from improper food handling. Multiply rapidly at room temperature to produce a toxin that causes illness. Symptoms: Severe nausea, abdominal cramps, vomiting, and diarrhea occur 1 to 6 hours after eating; recovery within 2 to 3 days - longer if severe dehydration occurs.

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A logo of the Radura symbol. The logo has an illustration of a circle with five lines cutting into it, in equidistant intervals, at the top half. There is a solid small circle in the center of the big circle and two leaf formations that meet each other below the smaller solid circle.

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A table of approximate composition of selected fast-food items. There are six columns: Food, Total calories, Total fat in grams, calories from fat, Cholesterol in milligrams and Sodium in milligrams. Row: 1. Food: Adult-sized hamburger beef. Total calories: 600. Total fat in grams: 29. Calories from fat: 260. Cholesterol in milligrams: 75. Sodium in milligrams: 1040. Row: 2. Food: Adult-sized burrito beef. Total calories: 410. Total fat in grams: 16. Calories from fat: 140. Cholesterol in milligrams: 30. Sodium in milligrams: 1140. Row: 3. Food: French fries medium and salted. Total calories: 450. Total fat in grams: 22. Calories from fat: 200. Cholesterol in milligrams: 0. Sodium in milligrams: 290. Row: 4. Food: Turkey sub sandwich. Total calories: 280. Total fat in grams: 4. Calories from fat: 30. Cholesterol in milligrams: 20. Sodium in milligrams: 730. Row: 5. Food: Fried chicken breast. Total calories: 360. Total fat in grams: 21. Calories from fat: 190. Cholesterol in milligrams: 110. Sodium in milligrams: 1080. Row: 6. Food: Cheese pizza 6 inch personal. Total calories: 590. Total fat in grams: 25. Calories

from fat: 220. Cholesterol in milligrams: 50. Sodium in milligrams: 1350. Row: 7. Food: Caesar salad no dressing. Total calories: 90. Total fat in grams: 5. Calories from fat: 45. Cholesterol in milligrams: 10. Sodium in milligrams: 180. Row: 8. Food: Caesar salad with dressing. Total calories: 390. Total fat in grams: 21. Calories from fat: 190. Cholesterol in milligrams: 50. Sodium in milligrams: 820. Row: 9. Food: Chocolate shake. Total calories: 690. Total fat in grams: 18. Calories from fat: 160. Cholesterol in milligrams: 40. Sodium in milligrams: 380. Row: 10. Food: Blended coffee drink with whipped cream. Total calories: 420. Total fat in grams: 9. Calories from fat: 180. Cholesterol in milligrams: 55. Sodium in milligrams: 270.

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A chart of health consequences of overweight. The background is a photo of a man and woman jogging. The following points have been listed: Early death, Obstructive sleep apnea, Snoring, Coronary artery disease, Surgical risk, High blood cholesterol, Diabetes type 2, Cancer, Arthritis, Stroke, High blood pressure, Gallbladder disease, Excessive sweating, Cirrhosis of the liver, Kidney problems, Low back pain, Gout, Varicose veins. Below are two lines. The first reads: Men: Colon, rectum, prostate. The second reads: Women: Breast, uterus, ovaries, gallbladder.

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A graph of overweight and obesity in the United States from 1999-2000 to 2017-2018. The horizontal axis represents years. The vertical axis represents percent from 20 to 80, in multiples of 2. The factor measured is percent overweight. The line begins in 1999-2000, there are 64.5 percent overweight. In 2003-2004, there are 66.4 percent overweight. In 2007-2008, there are 68.1 percent overweight. In 2011-2012, there are 68.6 percent overweight. In 2017-2018, there are 73.7 percent overweight.

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A table of the percentage of daily calories provided by typical fast-food meals. There are two columns: Meal and calorie levels per day. There are three sub columns under calorie levels per day: 1600, 2000 and 2500. Row: 1. Meals: Quarter pounder plus french fries plus milkshake. Calorie levels 1600: 73. Calorie levels 2000: 58. Calorie levels 2500: 47. Row: 2. Meals: Whopper plus french fries plus soft drink. Calorie levels 1600: 66. Calorie levels 2000: 54. Calorie levels 2500: 43. Row: 3. Meals: Two slices of pizza plus diet soft drink. Calorie levels 1600: 33. Calorie levels 2000: 25. Calorie levels 2500: 20.

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A table of body mass index table. To the top is the B M I line from 19 to 35. The height column is to the left from 4'10 to 6'3. The weight is measured in pounds. At the height of 4'10

and B M I of 19, weight is 91 pounds. At the height of 4'11 and B M I of 20, weight is 99 pounds. At the height of 5' and B M I of 21, weight is 107 pounds. At the height of 5'1 and B M I of 22, weight is 116 pounds. At the height of 5'2 and B M I of 23, weight is 126 pounds. At the height of 5'3 and B M I of 24, weight is 135 pounds. At the height of 5'4 and B M I of 25, weight is 145 pounds. At the height of 5'5 and B M I of 26, weight is 156 pounds. At the height of 5'6 and B M I of 27, weight is 167 pounds. At the height of 5'7 and B M I of 28, weight is 178 pounds. At the height of 5'8 and B M I of 29, weight is 190 pounds. At the height of 5'9 and B M I of 30, weight is 203 pounds. At the height of 5'10 and B M I of 31, weight is 216 pounds. At the height of 5'11 and B M I of 32, weight is 229 pounds. At the height of 6' and B M I of 33, weight is 242 pounds. At the height of 6'1 and B M I of 34, weight is 257 pounds. At the height of 6'2 and B M I of 35, weight is 272 pounds. At the height of 6'2 and B M I of 36, weight is 279 pounds.

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A bar graph of relative health risks of various body mass indexes. The horizontal axis represents body mass index. The vertical axis represents relative risk. The factors measured are: poor health, high blood pressure, type 2 diabetes and arthritis. In body mass index between 25-29.9, poor health is at 1 relative risk, type 2 diabetes is at approximately over 1 relative risk, high blood pressure is at approximately 1 and half relative risk and arthritis is at

approximately 1 relative risk. In body mass index between 30-39.9, poor health is at approximately over 1 and half relative risk, type 2 diabetes is at approximately 3 relative risk, high blood pressure is at approximately over 3 relative risk and arthritis is at approximately 2 relative risk. In body mass index between 40 plus, poor health is at approximately 4 relative risk, type 2 diabetes is at approximately 7 and half relative risk, high blood pressure is at approximately over 6 and half relative risk and arthritis is at approximately 6 and half relative risk.

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A set of illustrations depicting apple or pear body shape. The first shows a body of a man. His upper torso is covered by an apple or android. The second shows a body of a woman. Her upper torso is covered with a pear or gynoid.

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A line graph of weight loss from adherence to several popular diet programs. The horizontal axis represents months on diet, from 2 to 12. The vertical axis represents percent reduction in body weight: 15, 10, 5 and 0. There are four factors measured: weight watchers, zone, atkins and ornish. The weight watchers line begins at 0 percent reduction. By 2 months on diet, it is down to approximately just over 10 percent. By 12 months, it is at 10 percent. The atkins line begins at 0 percent reduction. By 2 months, it is at

approximately less than 10 percent. By 6 months, it has come further down to approximately 12 percent. By 12 months, it rises up to approximately 8 percent. The zone line begins at 0 percent reduction. By 2 months, the line has come down to approximately 10 percent reduction. By 6 months, it has come further down to 13 percent. By 12 months, the line has risen up to approximately 13 percent. The ornish line begins at 0 percent reduction. By 2 months, it has come down to approximately 15 percent reduction. The line moves consistently along a linear, ending at approximately just over 15 percent reduction by 12 months.

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A line graph of adherence to popular weight-management diets. The horizontal axis represents months on diet and vertical axis represents adherence level from 2 to 10 in multiples of 2. The line begins at an adherence level of approximately 7. By 4 months, the level is down to approximately 3 and half. By 8 months, the line is further down to approximately just over an adherence level of 3. The line ends at approximately back to an adherence level of 3 and half by 12 months.

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A table of approximate energy expenditures during various activities. There are two columns: Intensity and Exercise. Row: 1. Intensity: Light exercise of 4 calories per minute.

Exercise: Cycling 5 m p h, Slow dancing ,Table tennis, Walking 3 m p h, Volleyball, Yoga, Canoeing, Softball, T'ai chi ch'uan, House cleaning, Golf. Row: 2. Intensity: Moderate exercise of 7 calories per minute. Exercise: Tennis, Basketball, Snowshoeing, Fast dancing, Swimming 30 meters per minute, Walking 4.5 m p h, Cycling 9 mph, Heavy gardening, Roller skating. Row: 3. Intensity: Heavy exercise of 10 calories per minute. Exercise: Jogging, Mountain climbing, Skiing, Climbing stairs, Cycling 12 m p h, Ice skating, Football, Handball and racquetball.

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A bar graph of sedentary behavior among American adults by age. The horizontal axis represents age in years and the vertical axis represents percent sedentary from 20 to 60 in multiples of 2. Between 18 to 39 years, the sedentary percentage is 27 percent. Between 40 to 64 years, the sedentary percentage is 35 percent. Over 65 years, the sedentary percentage is 43 percent.

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A line graph of financial incentives to get healthy. The horizontal axis represents months and the vertical axis represents percent participation from 20 to 100 in multiples of 2. There are three factors measured: Pay 4 play, double winner and take the money and run. The pay 4 play line begins at approximately less than 40 percent participation.

The line begins to decline gradually, ending at approximately a little over 30 percent in 3 months. The take the money and run line begins a little under 50 percent participation. The line moves along a linear path, ending a little under 50 percent in 3 months.

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An illustration of the human movement system. There is an illustration of a man pulling up a string with her left arm while flexing his biceps. The brain has been labeled. The motor nerve connects the brain to the bicep muscle and bicep tendon. The humerus bone is at the shoulder. The ulna bone is at the elbow and the radius bone is at the forearm.

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A bar graph of physical activity levels. The horizontal axis represents lifestyle and the vertical axis represents physical activity level: 1.0, 1.4, 1.7 and 2.0. In the first bar, Basal life is at a physical activity level of 0 to 1.0 while Sedentary is at a physical activity level of 1.0 to 1.4. In the second bar, Basal life is at a physical activity level of 0 to 1.0 while Moderate is at a physical activity level of 1.0 to close to approximately 1.7. In the third bar, Basal life is at a physical activity level of 0 to 1.0 while Vigorous is at a physical activity level of 1.0 to 2.0.

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A list of put a little movement in your life. The following points are listed: 1. Park your car a 10-to-15-minute walk from your destination. 2. Walk or march in place when on your phone. 3. Walk or march in place during every TV commercial. 4. Use a table, desk or chair to do push-ups: Stand and place your hands on a table, a desk, or the back of chair and perform 10 push-ups. 5. Set phone timer: At your desk, move or stretch at least 3 to 4 minutes every hour. 6. Chair on fire: Sit on edge of chair; stand; sit and then stand immediately, chair on fire; do 10 reps. 7. Walk during breaks and lunch. Don't eat and sit the entire time. 8. Hold walking meetings. Stand during presentations or webinars. 9. Take the stairs, not the elevator. 10. Take the longest walking route feasible to the restroom, even if you have to go to another floor. 11. Take the longest walking route to any source of food. 12. Do partial squats, knee, and calf raises while waiting to use office equipment such as copiers, microwaves, and fax machines. 13. Keep a resistance band to perform strengthening and stretching exercises at your desk or while watching TV. 14. Walk or jog in place for 2 minutes whenever you get up from your desk. 15. Desk dance. Move your feet, arms, and shoulders to favorites from your playlist. 16. Keep an exercise log to keep you focused. 17. Walk or talk with a buddy to keep it fun. 18. Listen to audiobooks to keep it interesting. 19. Walk a dog to be a pal.

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A line graph of relative health benefit of physical activity. The horizontal axis represents relative level of daily physical activity from 1 to 5 and the vertical axis represents relative health benefit from 1 to 5. The line begins at a relative level of daily physical activity of 0 and relative health benefit of 1. The line begins to rise, touching a relative level of daily physical activity of 2 and relative health benefit of a little over 3. The line then rises marginally and follows a linear path, ending at a relative level of daily physical activity of 5 and relative health benefit of a little under 4.

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A chart depicting heart-rate pattern for a typical exercise routine. There are three columns: Warm up 10 minutes, Exercise 30 minutes and Cool down 10 minutes. The vertical axis represents heart rate pulse. There is a line at the top running horizontally through the three columns called Maximum rate. There is a line at the bottom running horizontally through the three columns called Resting rate. Below the maximum rate line is a rectangular area running through the three columns horizontally, called the Target zone. A line begins just above the resting rate line in the warm up column, rises to the target zone and runs within the zone all through the exercise column and begins to fall back down towards the resting rate line in the cool down column.

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A chart depicting getting into shape. There are three columns: Warm up 10 minutes, Exercise 30-60 minutes and Cool down 10 minutes. The vertical axis represents heart rate pulse. There is a line at the top running horizontally through the three columns called Maximum rate. There is a line at the bottom running horizontally through the three columns called Resting rate. Below the maximum rate line is a rectangular area running through the three columns horizontally, called the Exercise target heart rate. A line begins just above the resting rate line in the warm up column, rises to the target zone and runs within the zone all through the exercise column and begins to fall back down towards the resting rate line in the cool down column.

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A photo of position 1 in sun salute. A woman is standing to her left, with her feet joint together and her palms clapsed together. A photo of position 2 in sun salute. A woman is standing to her left, with her feet joint together and her palms joint together straight above her head. A photo of position 3 in sun salute. A woman is standing to her left, with her feet joint together. Her head is bent down to her knees and her hands and touching the ground to the side of her feet. A photo of position 4 in sun salute. The woman's right leg is in the front and her left leg is stretched behind. She is sitting on her right leg with both hands touching the ground to the sides of her right foot. She is looking up. A photo of position 5 in sun salute. The woman's legs are straight behind, joint

together, and her hands are holding her body straight along with her toes. A photo of position 6 in sun salute. The woman's knees, chest and chin are touching the floor and her hips are up and toes are curled under. A photo of position 7 in sun salute. The tops of the woman's feet are touching the floor and her legs are straightened behind. She has lifted her body off the ground while supporting her body with her palms. Her head is facing upwards towards the ceiling. A photo of position 8 in sun salute. The woman's body is arched like an inverted V. Her hips are at the top while her legs and hands are straight to form the V shape. Her head is hanging down. A photo of position 9 in sun salute. The woman's left leg is in the front and her right leg is stretched behind. She is sitting on her left leg with both hands touching the ground to the sides of her left foot. She is looking up. A photo of position 10 in sun salute. A woman is standing to her left, with her feet joint together. Her head is bent down to her knees and her hands are touching the ground to the side of her feet. A photo of position 11 in sun salute. A woman is standing to her left, with her feet joint together and her palms joint together straight above her head. A photo of position 12 in sun salute. A woman is standing to her left, with her feet joint together and her palms clapsed together.

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A scale that measures urine. The numbers 1 to 8 are placed in ascending order in rectangular boxes. From 1 to 3, the levels are described as: Properly hydrated - If your urine

matches the colors 1–3, above the red line, you are properly hydrated and should continue to consume fluids at the recommended amounts. From 4 to 8, the levels are described as: Dehydrated - If your urine matches the colors 4–8, you are dehydrated and at risk for cramping and heat illness. You need to drink more water or sports drink.

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A table of a comparison of contraceptive methods. There are four columns: Effectiveness, Method, Advantages and Disadvantages. Row: 1. Effectiveness: Low effectiveness. Method: Withdrawal. Advantages: No health problems. Disadvantages: Requires considerable ejaculatory control. Row: 2. Effectiveness: Low effectiveness. Method: Spermicides. Advantages: No health problems; no prescription required. Disadvantages: Must be used with each incidence of intercourse; messy. Row: 3. Effectiveness: Low effectiveness. Method: Fertility awareness. Advantages: No health problems. Disadvantages: Difficult to predict safe days; several days of abstinence may be required. Row: 4. Effectiveness: Low effectiveness. Method: Female condom. Disadvantages: Vaginal irritation; must be used prior to intercourse. Row: 5. Effectiveness: Moderate effectiveness. Method: Male latex condom. Advantages: No health problems; no prescription required. Disadvantages: May break or tear. Row: 6. Effectiveness: Moderate effectiveness. Method: Diaphragm. Advantages: No health problems. Disadvantages: Must be used before intercourse; must be fitted by a clinician. Row: 7.

Effectiveness: Moderate effectiveness. Method: Cervical cap. Advantages: Can remain in place for up to 24 hours. Disadvantages: Must be fitted by a clinician; cervical irritation. Row: 8. Effectiveness: High effectiveness. Method: Combination hormonal methods like pills, patch, ring, injection. Advantages: Easy to use. Not intercourse dependent. Disadvantages: Side effects; serious risks to health in some users. Row: 9. Effectiveness: High effectiveness. Method: Progestin-only methods like mini-pill, injection. Advantages: Easy to use. Not intercourse dependent. Disadvantages: Side effects. Row: 10. Effectiveness: High effectiveness. Method: I U D. Advantages: Not intercourse dependent. Disadvantages: Side effects. Row: 11. Effectiveness: High effectiveness. Method: Surgical sterilization tubal ligation; vasectomy. Advantages: One-time procedure. Disadvantages: Some postsurgical discomfort.

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A set of illustrations depicting fertilization and early development of the embryo. The Ovaries release the unfertilized egg from the follicle into a pipe that has an opening which resembles the tentacles of a plant. At first is the fertilization with the sperm cell. After 24–30 hours after fertilization: Male and female genetic material combines. The egg continues to move down the pipe. After 36 hours, there are 2 cells. After 48 hours, there are 4 cells. After 3 days, there are 16-32 cells. The egg now enters a uterus. After 4

days, there is a hollow ball of 64-128 cells called the blastocyst. The egg moves down the uterus while touching the endometrium. By 6 or 7 days: Blastocyst attaches itself to the uterine wall. By 11 or 12 days: Implantation of the embryo has occurred.

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An illustrated diagram with several parts for the menstrual cycle. The first part gives a cross section of the brain. The anterior lobe of the pituitary gland is magnified from the first illustration. It is a tiny structure with sacs at the end, from which F S H and L H are released. Below, an illustration has 5 parts. The first part depicts a primary follicle developing in the ovary. Next, the follicle matures and expands. The third part depicts ovulation, where the ovum exits the wall of the ovary. The next part depicts the corpus luteum inside the ovary. The last part depicts degenerating corpus luteum inside the ovary. The F S H acts in the first 3 parts. F S H and L H influence the third part, which is the ovulation. The last two phases have L H indicated. The following illustrations are placed against a timeline that depicts the menstrual phase from day 1 to 5, proliferative phase at day 10, ovulation is at day 15, secretory phase is at day 20, and the menstrual phase resumes at day 28 onward. The third set of illustrations has the phases of the lining of the uterus. From day 1 to day 5, the lining diminishes. From day 5 to 20, the lining grows and there are more active glands in and around the uterus. From day 20 to 28, the lining and activity

grows, and after day 28, the lining breaks down. The fourth part depicts the drop and rise in hormonal levels.

Progesterone rises to its peak around day 20 and drops by day 28. Estrogen rises to its peak after day 10 and then falls to rise once more around day 20 and drops by day 28. L H rises to a peak between day 10 and day 15 and drops after that. F S H has a wavy drop and rise through the menstrual cycle.

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A bar graph depicting estimated yearly number of S T Ds in the United States, 2020. The horizontal axis represents annual number of cases from 1 to 13. The vertical axis represents the S T Ds. Trichomoniasis has 6.9 million cases while Chlamydia has 1.8 million cases. Genital warts has 13 million cases, which is the highest. Gonorrhea has 616000 cases and Herpes has 570000 cases. Acute hepatitis B has 8300 cases while Syphilis has 140000 cases.

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An illustration depicting factors affecting the risk of an infectious disease. There is an illustration of a woman's body with the brain, trachea lungs, heart, spine and large intestine depicted. To the left is the word internal, and under it are the following: Age, Sex, Immunological competence, Previous infections, Hormonal status, Presence of other diseases, Nutritional status, Emotional stress level and Heredity. To the

right is the word external, and under it are the following: Infection in the community, Season of year, Hygiene and sanitation, Drugs and medications, Environmental pollutants or toxins.

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A set of illustrations depicting the human microbiome. To the left is an illustration of a man's body and to the right is an illustration of the man's body from the back. The following parts are labeled. Figure 1: The eyebrow, inside ear and nose is depicted. This is followed by the armpit, inside elbow, fingers, naval and groin are labeled. To the legs are the toes and between the toes. Figure 2: The scalp are behind the ears are labeled, followed by the back, between fingers, buttocks and feet.

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An illustration of the inflammation response. The skin is the topmost layer. Under this is a thicker layer that ends in a wave at the bottom. Under the wave are circular blood cells and even smaller circular mast cells. There is a nail logged into the three layers from the skin. The first line reads: Dirty nail penetrates skin, allowing bacteria to enter. The second line reads: Blood vessels dilate, causing area to become red and hot. The third line reads: Histamine released. The fourth line reads: White blood cells rush to area to attack bacteria.

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A set of illustrations depicting the lymphatic and immune systems. There is an illustration of a woman's body. To the cheek is the Adenoid and towards the chin is the Tonsil. The right lymphatic duct is below the neck and beside it is the subclavian vein. Just above the Thymus is the Superior vena cava. Under the heart is the thoracic duct and below that is the spleen. Within the small intestine is the Peyer's patch and to the right bottom of the large intestine is the appendix. Within the upper thigh, towards the pelvis, is the lymph node. There lead down to the lymphatic vessels. The bone marrow is situated on the upper thigh bone.

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A table of specialised white blood cells. There are four columns: White blood cell type, Description, Function and Life Span. Row: 1. White blood cell type: Neutrophil. Description: Spherical; with many-lobed nucleus, no hemoglobin, pink-purple cytoplasmic granules. Function: Cellular defense—phagocytosis of small microorganisms. Life Span: Hours to 3 days. Row: 2. White blood cell type: Eosinophil. Description: Spherical; two-lobed nucleus, no hemoglobin, orange-red staining cytoplasmic granules. Function: Cellular defense—phagocytosis of large microorganisms such as parasitic worms; releases anti-inflammatory substances in allergic reactions.. Life Span: 8 to 12 days. Row: 3. White blood cell type: Basophil. Description: Spherical; two-lobed nucleus, no hemoglobin, large purple-staining cytoplasmic granules. Function:

Inflammatory response—contains granules that rupture and release chemicals enhancing inflammatory response. Life Span: Hours to 3 days. Row: 4. White blood cell type: Monocyte. Description: Spherical; single nucleus shaped like kidney bean, no cytoplasmic granules, cytoplasm often blue in color. Function: Converted to macrophages, which are large cells that entrap microorganisms and other foreign matter. Life Span: Days to months. Row: 5. White blood cell type: B lymphocyte. Description: Spherical; round singular nucleus, no cytoplasmic granules. Function: Immune system response and regulation; antibody production sometimes causes allergic response. Life Span: Days to years. Row: 6. White blood cell type: T lymphocyte. Description: Spherical; round singular nucleus, no cytoplasmic granules. Function: Immune system response and regulation; cellular immune response. Life Span: Days to years.

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A diagram of the chemistry of an allergic reaction. There are two circular-shaped mast cells with antenna-shaped I g E to which the allergen has attached itself. Both have released Histamine and chemical mediators of the allergic response. The first mast cell has also shed its allergens into the skin. There is mucus emitting from the top.

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An illustration of autoimmune diseases. There is an illustration of a man's body. An arrow pointing to his eye, shoulder joint and genitals reads: Reiter's syndrome: T cells attack tissues in eyes, joints, and genital tract. An arrow pointing to his thymus reads: Graves' disease: Antibodies attack thyroid gland. An arrow pointing to his kidney, pelvic bone and bicep reads: Systemic lupus erythematosus: Widespread antibody attack affects joints, skin, kidneys, and other organs. An arrow pointing to the heart reads: Rheumatic fever: Antibodies attack heart muscle. An arrow pointing to the pancreas reads: Type 1 diabetes mellitus: T cells attack insulin-making cells in pancreas. An arrow pointing to the thigh bone reads: Myasthenia gravis: Antibodies attack neuromuscular junctions. An arrow pointing to the thigh reads: Psoriasis: T cells attack skin. An arrow pointing to the knee reads: Rheumatoid arthritis: T cells attack joints.

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An illustration of antigens and the immune system. There is an illustration of several small circular formations, of the same size, with tentacles under them. These are the cell membrane. They are placed in a square pattern with a few facing upwards and few facing downwards, with their tentacles meetings at the center. There is a big shape-less formation between the cell membranes which are the H L As.

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A table of permissible transfusions determined by A B O blood group. There are five columns: Blood group, Genotype, Antigens on red blood cells, Transfusions cannot be accepted from and Transfusions are accepted from. Row: 1. Blood group: O universal donor. Genotype: OO. Antigens on red blood cells: None. Transfusions cannot be accepted from: A, B, AB. Transfusions are accepted from: O. Row: 2. Blood group: A. Genotype: AA, AO. Antigens on red blood cells: A. Transfusions cannot be accepted from: B, AB. Transfusions are accepted from: A, O. Row: 3. Blood group: B. Genotype: BB, BO. Antigens on red blood cells: B. Transfusions cannot be accepted from: A, AB. Transfusions are accepted from: B, O. Row: 4. Blood group: AB universal recipient. Genotype: AB. Antigens on red blood cells: A, B. Transfusions cannot be accepted from: None. Transfusions are accepted from: A, B, AB, O.

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A table depicting My Vaccination record. There are three columns: Vaccine, Year Initial Series Completed, Years Revaccinated. Row: 1. Vaccine: Diphtheria. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 2. Vaccine: Hepatitis A. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 3. Vaccine: Hepatitis B. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 4. Vaccine: Influenza. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 5. Vaccine: Measles.

Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 6. Vaccine: Mumps. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 7. Vaccine: Pertussis or whooping cough. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 8. Vaccine: Polio. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 9. Vaccine: German measles or rubella. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 10. Vaccine: Tetanus. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 11. Vaccine: Tuberculosis. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled. Row: 12. Vaccine: Other. Year Initial Series Completed: To be filled. Years Revaccinated: To be filled.

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A chart of the core behaviors for a healthy heart. There is an illustration of fruits and vegetables along with an illustration of a man walking. The following points are listed in the chart:

1. Eat healthy especially fruits, vegetables, legumes, nuts, seeds, and whole grains.
2. Sit less, move your body, take a walk.
3. No tobacco smoking.
4. Maintain healthy blood pressure.
5. Go easy on fats and cholesterol.
6. Go easy on sugar.
7. Go easy on alcohol.
8. Maintain a healthy body weight.
9. Take time outs to ease your mind.
10. Relax, have fun, be social.

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A graph of mortality from cardiovascular disease in the United States from 1980 to 2018. The horizontal axis represents years from 1980 to 2018. The vertical axis represents deaths in thousands. The factors measured are Males and Females. The Males line begins in 1980 at less than 400000 deaths. It begins to decline, touching approximately 280000 deaths in 2000. The line ends in 2018 at 120000 deaths. The Females line begins in 1980 at approximately 300000 deaths. It steadily begins to decline, touching the males line at approximately 280000 deaths in 2000. The line ends in 2018 at 130000 deaths.

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An illustration of the cardiovascular system depicting the heart, veins and artery. The veins are labeled as follows: The External and Internal jugular vein is at the neck. The superior vena cava and Pulmonary vein is within the heart. The Branchial vein is at the bicep. The Inferior vena cava is below the heart and the Renal vein is below it. The Femoral vein is towards the pelvis. The arteries are labeled as follows: The Vertebral artery and Common carotid artery is at the neck. The Ascending aorta and Pulmonary arteries are in the heart. The Renal artery is below the heart. The Brachial artery is at the bicep. The Abdominal aorta is in the abdomen. The Femoral artery is in the upper thigh.

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An illustration of the heart and major arteries. To the left of the heart, from top to bottom, first is the Aortic pump at the top. The Left pulmonary artery is under the aortic arch. Next comes the Auricle or left atrium. The left coronary artery is at the center of the heart. The left ventricle is below the the left end. Right at the bottom emerges the Descending aorta. The Ascending aorta is a tube at the top center of the heart. The Right atrium is below to the right. The Right coronary artery is just towards the bottom right and the Right ventricle is below that.

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An illustration of a defibrillator. There is an illustration of a man's upper torso. The right ventricle is at the bottom right of the heart and right atrium is at the top of the heart. There is a Defibrillator, which is a small metal box, inserted under the skin on the left chest. There are wires coming out of the device which are electrodes inserted into vein. The electrodes connected into the heart.

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An illustration of the heart valves. There is a triangular formation. To the top is a semi circular formation which are the Pulmonary semilunar valves. Below this is a bean-shaped formation which are the Aortic semilunar valves. Below are two large circular-shaped formations attached to

each other at the sides. Within them is a big mass. To the right is the Tricuspid valve and to the left is the Mitral valve.

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An illustration of the development of an Atherosclerotic lesion or plaque inside an artery. There are four tube-like formations placed one above another. Between the outer and inner rim of the first tube is a normal smooth muscle cell. On the inner rim is a rupture which is the damaged endothelium. In the second tube is an extra layer on the inner rim which is the fatty streak. There is a line which reads: Fatty deposits accumulate in muscle cell. In the third tube there is a larger additional layer to the inner rim with fats and fibers. These are fibrous plaque. In the fourth tube, the area has grown larger and this is a large plaque obstructing the artery.

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An illustration of the coronary arteries showing where grafts are made to correct blockages. A tube formation at the top of the heart is the Aorta and under it is the Pulmonary artery. There are several fibrous formations surrounding the heart. One is the Saphenous vein graft to left coronary artery. The other is the Saphenous vein graft to right coronary artery. There is a block in the left coronary artery. There is a line which reads: Once bypass is performed, this blocked section is removed.

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A line graph depicting association of maintaining healthy lifestyle factors on the risk of cardiovascular disease. The horizontal axis represents number of healthy lifestyle factors from 1 to 7. The vertical axis represents risk of death from 10 to 110, in additions of 10. There are three factors measured: All cause, C V D and C H D. The All cause line begins with 1 healthy lifestyle factor at a 100 risk of death. The line begins to drop until 4 healthy lifestyle factor at a 65 risk of death. The line rises momentarily before ending at 7 healthy lifestyle factor at a 50 risk of death. The C V D line begins with 1 healthy lifestyle factor at a 100 risk of death. The line begins to drop until 3 healthy lifestyle factor at a 55 risk of death. The line descends further before ending at 7 healthy lifestyle factor at a 25 risk of death. The C H D line begins with 1 healthy lifestyle factor at a 100 risk of death. The line begins to drop until 3 healthy lifestyle factor at a 55 risk of death. The line descends further before ending at 7 healthy lifestyle factor at a 30 risk of death.

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A table of recommended screenings tests for cancer detection and prevention. There are four columns: Test, Sex, Age and Frequency of testing. Row: 1. Test: Colonoscopy. Sex: M and F. Age: 50 and over. Frequency of testing: Every 10 years. Row: 2. Test: Flexible sigmoidoscopy. Sex: M and F. Age: 50 and over. Frequency of testing: Every 5 years. Row: 3. Test: Double-contrast barium enema. Sex: M and F. Age: 50 and over. Frequency of testing: Every 5 years. Row:

4. Test: Fecal occult blood test. Sex: M and F. Age: 50 and over. Frequency of testing: Every year. Row: 5. Test: Fecal immunochemical test. Sex: M and F. Age: 50 and over. Frequency of testing: Every year. Row: 6. Test: F I T - D N A test. Sex: M and F. Age: 50 and over. Frequency of testing: Every year. Row: 7. Test: Digital finger rectal examination. Sex: M. Age: 50 and over. Frequency of testing: Every year. Row: 8. Test: Prostate-specific antigen. Sex: M. Age: 50 and over. Frequency of testing: Every year. Row: 9. Test: Pap-test. Sex: F. Age: 18 and over. Frequency of testing: Women should begin getting a Pap test with the start of sexual activity, but no later than at 21 years of age, and repeat the test at least every 3 years. Row: 11. Test: Breast self-examination. Sex: F. Age: 20 and over. Frequency of testing: Every month. Row: 12. Test: Breast clinical examination. Sex: F. Age: 20-40. 40 and over. Frequency of testing: Every 3 years. Every year. Row: 13. Test: Mammography. Sex: F. Age: 40 and over. Frequency of testing: Every 1-2 years.

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A bar graph of the estimated number of new cancer cases, United States, 2021. The horizontal axis represents number of cases in thousands while the vertical axis represents cause. The two factors measured are male and female. Ovary has 21410 thousand cases. Bladder or kidney has 113060 thousand cases in men and 44750 thousand cases in women. Pancreas has 31950 thousand cases in men and 28480 thousand cases in women. Leukemia and non-

Hodgkin lymphoma has 80890 thousand cases in men and 41490 thousand cases in women. Colon and rectum has 52590 thousand cases in men and 51680 thousand cases in women. Prostate has 248530 thousand cases in men. Breast has 281550 thousand cases in women. Lung and bronchus has 119100 thousand cases in men and 114460 thousand cases in women. All have 836150 thousand cases in men and 852430 thousand cases in women.

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A pie chart of four major categories of cancers and approximate frequencies of occurrence. The largest slice is carcinoma at 80-90 percent of all cancers. The text reads: Cancer originates from epithelial tissues such as skin, membranes around glands, nerves, breasts, and linings of respiratory, urinary, and gastrointestinal tracts. The second largest slice is lymphoma at 5 percent of all cancers. The text reads: About 5 percent of all cancers, the most common being Hodgkin's disease. Lymphoma is similar to leukemia and involves abnormal production of white blood cells by the spleen and lymph system. The third largest slice is Leukemia at 4 percent of all cancers. The text reads: Leukemia is a cancer of lymph glands, bone marrow, and organs that form blood cells and results from overproduction of immature white blood cells. The last is Sarcoma at 2 percent of all cancers.

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A bar graph of the estimated number of deaths from common cancers, United States, 2021. The horizontal axis represents number of deaths in thousands while the vertical axis represents cause. The two factors measured are male and female. Ovary has 13370 thousand cases. Bladder or kidney has 21050 thousand cases in men and 9930 thousand cases in women. Pancreas has 25270 thousand cases in men and 22950 thousand cases in women. Leukemia and non-Hodgkin lymphoma has 24070 thousand cases in men and 18310 thousand cases in women. Colon and rectum has 28520 thousand cases in men and 24460 thousand cases in women. Prostate has 34130 thousand cases in men. Breast has 43600 thousand cases in women. Lung and bronchus has 69410 thousand cases in men and 42470 thousand cases in women. All have 319420 thousand cases in men and 289150 thousand cases in women.

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A set of illustrations explain how colorectal cancer develops. A. The epithelial cells lining the colon are arranged side by side, of the same size. They are line long rectangles with an oval nucleus inside. Caption. Normal colon. Genes A P C, h M S H 2, h M L H 1. Inherited abnormalities. B. There are many shorter rectangular cells on top of the line of epithelial cells. Caption. Hyperproliferative Epithelium. Genes A P C, h M S H 2, h M L H 1. Inactivation. C. A cross section of a thickened inner lining of the colon that has a random shape. It is an additional growth. Caption. Adenoma. Further

mutations and other changes occur. D. Many cells grow along the colon wall, outside, and spread inside the colon as well. The cells have random shapes, and the nucleus appears small and different from the epithelial cells. Caption. Colon cancer. Further accumulation of genetic abnormalities in colon cells.

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There is a diagram depicting environmental factors that cause cancer. To the left is an arrow pointing to the right that reads: Factors that change genes in cells. The following text is within the arrow: 1. Ionizing radiation 2. Infectious microorganisms viruses and bacteria. 3. Carcinogenic chemicals. To the right is an arrow pointing to the left that reads: Factors that promote growth of genetically abnormal cells. The following text is within the arrow: 1. Hormones. 2. Nutritional deficiencies. 3. Reduced immune system. 4. Aging. 5. Immunosuppressive drugs. Between both arrows are multiple rectangular-like shapes and circular-like shapes stacked against each other which is the tumor. There is a small circle within each of these shapes.

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A table of examples of occupational cancers. There are four columns: Chemical or physical agent, Cancer type, Exposure of general population and Examples of workers frequently exposed or exposure sources. Row: 1. Chemical or physical

agent: Arsenic. Cancer type: Lung, skin. Exposure of general population: Rare. Examples of workers frequently exposed or exposure sources: Insecticide and herbicide sprayers, tanners, oil refinery workers. Row: 2. Chemical or physical agent: Asbestos. Cancer type: Mesothelioma, lung. Exposure of general population: Uncommon. Examples of workers frequently exposed or exposure sources: Brake-lining, shipyard, insulation, and demolition workers. Row: 3. Chemical or physical agent: Benzene. Cancer type: Myelogenous leukemia. Exposure of general population: Common. Examples of workers frequently exposed or exposure sources: Painters, distillers and petrochemical workers, dye users, furniture finishers, rubber workers. Row: 4. Chemical or physical agent: Diesel exhaust. Cancer type: Lung. Exposure of general population: Common. Examples of workers frequently exposed or exposure sources: Railroad and bus-garage workers, truck operators, miners. Row: 5. Chemical or physical agent: Formaldehyde. Cancer type: Nose, nasopharynx. Exposure of general population: Rare. Examples of workers frequently exposed or exposure sources: Hospital and laboratory workers; manufacture of wood products, paper, textiles, garments, and metal products. Row: 6. Chemical or physical agent: Hair dyes. Cancer type: Bladder. Exposure of general population: Uncommon. Examples of workers frequently exposed or exposure sources: Hairdressers and barbers inadequate evidence for customers. Row: 7. Chemical or physical agent: Ionizing radiation. Cancer type: Bone marrow, several others.

Exposure of general population: Common. Examples of workers frequently exposed or exposure sources: Nuclear materials, medicinal products and procedures. Row: 8. Chemical or physical agent: Mineral oils. Cancer type: Skin. Exposure of general population: Common. Examples of workers frequently exposed or exposure sources: Metal machining. Row: 9. Chemical or physical agent: Nonarsenic pesticides. Cancer type: Lung. Exposure of general population: Common. Examples of workers frequently exposed or exposure sources: Sprayers, agricultural workers.

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Row: 10. Chemical or physical agent: Painting materials. Cancer type: Lung. Exposure of general population: Unommon. Examples of workers frequently exposed or exposure sources: Professional painters. Row: 11. Chemical or physical agent: Polychlorinated biphenyls. Cancer type: Liver, skin. Exposure of general population: Unommon. Examples of workers frequently exposed or exposure sources: Heat-transfer and hydraulic fluids and lubricants, inks, adhesives, insecticides. Row: 12. Chemical or physical agent: Radon alpha particles. Cancer type: Lung. Exposure of general population: Unommon. Examples of workers frequently exposed or exposure sources: Mines; underground structures; homes. Row: 13. Chemical or physical agent: Soot. Cancer type: Skin. Exposure of general population: Unommon. Examples of workers frequently

exposed or exposure sources: Chimney sweeps and cleaners, bricklayers, insulators, firefighters, heating-unit service workers. Row: 14. Chemical or physical agent: Synthetic mineral fibers. Cancer type: Lung. Exposure of general population: Uncommon. Examples of workers frequently exposed or exposure sources: Wall and pipe insulation, duct wrapping.

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A diagram of the DNA molecule of life. At the top is a circular formation, which is the cell. Within the cell is the irregular-shaped genome. Chromosomes travel and transform into the DNA, which is a criss-cross formation. They are the genes. The genes contain instructions for making proteins. Below the DNA formation is an arrow going to the right. On it are three irregular-shaped formations which are the proteins. There are dotted arrows pointing to the proteins from the DNA. Proteins act alone or in complexes to perform many cellular functions. At the end of the arrow is a formation made from the three proteins.

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A line graph and an illustration of the karyotype of individual with Down syndrome. First is the line graph. The horizontal axis represents age of mother, while the vertical axis represents incidence per thousand births. The line begins at 15 years at 0 incidence per thousand births. It follows a linear

path until 40 years before shooting up to 100 incidence per thousand births after 40. The second is the illustration. There are 22 pairs of curvy lines. However, the 21st pair has an extra line, making it a trio.

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A table of chromosomal abnormalities. There are four columns: Genetic disease or disorder, Chromosomal defect, Incidence per live births and Symptoms. Row: 1. Genetic disease or disorder: Turner's syndrome female.

Chromosomal defect: Missing X. Incidence per live births: 1 per 1000. Symptoms: Absence of ovaries, short stature, underdeveloped breasts. Row: 2. Genetic disease or disorder: Klinefelter's syndrome male. Chromosomal defect: Extra X. Incidence per live births: 1 per 1000. Symptoms: Small, undeveloped testes, sterility, intellectual disabilities.

Row: 3. Genetic disease or disorder: Down syndrome male or female. Chromosomal defect: Extra chromosome 21.

Incidence per live births: 1 per 700. Symptoms: Physical abnormalities, intellectual disabilities, heart defects. Row: 4.

Genetic disease or disorder: X X X syndrome female.

Chromosomal defect: Extra chromosome 21. Incidence per live births: 1 per 700. Symptoms:

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A table of my family medical history. There are four columns: Relation, Disease, If deceased, age of death and Cause of

death. There are six sub columns under disease: Cancer, diabetes, heart disease, hypertension, stroke and other. The details under relation are: Father, Mother, Brother, Brother, Sister, Sister, Father's father, Father's mother, Father's brother or sister, Mother's father, Mother's mother, Mother's brother or sister. All other categories have to be filled.

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A diagram of amniocentesis. There is a set of illustrations. To the left is the illustration of a baby in the womb. The amniotic cavity is around the baby and the placenta is towards the the baby's legs. The second is an illustration of a centrifuge with liquid in it, which is the amniotic fluid withdrawn from cavity. There are cells from the amniotic fluid at the bottom of the fluid. To the right is an illustration of a flat circular dish with cells in it used for cell culture analyzed for biochemical or chromosomal defects.

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An illustration of isolation of embryonic stem cells. To the top is an illustration of a circular formation with two eggs in it. These are eggs fertilized in laboratory. There is an arrow pointing downward to a group of circular formations conjoined together. There is an outer cell mass and an inner cell mass. This is the blastocyst at 5 to 6 days. There is an arrow pointing down to the flat circular dish with little irregular formations inside. These are embryonic stem cells. The

arrow reads: Inner cells cultured. From here, three arrows lead down from the dish. They are stem cells exposed to differentiation factors. The first arrow leads to a group of circles which are blood cells. The second arrow leads to diamond-shaped formations which are muscle cells and the third leads to star-shaped formations which are neural cells.

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A line graph of a study of effectiveness of ibuprofen versus acetaminophen in relieving headaches. The horizontal axis represents time in hours and the vertical axis represents Percentage of individuals free of headache pain. The three factors measured are ibuprofen, acetaminophen and placebo. The ibuprofen line begins a little after 0.5 hours at approximately 5 percent individuals and begins to go up to approximately 50 percent of individuals at 3 hours. From here, it further rises up before ending at approximately 60 percent individuals at 4 hours. The acetaminophen line begins a little after 0.5 hours at approximately 5 percent individuals and begins to go up to approximately 45 percent of individuals at 3 hours. From here, it further rises up before ending at approximately 50 percent individuals at 4 hours. The placebo line begins at 0. It steadily rises up to approximately 30 percent individuals at 3 hours. The line further rises before ending at approximately less than 40 percent of individuals at 4 hours.

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A diagram of bindings of drugs to cellular receptors. There are three layers of wall with differently shaped cut-outs in between. To the top left are three differently shaped figures, which are molecules and, to the top right, are three differently shaped figures which are drugs. There are a few drugs that are logged into the second layer of wall.

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An illustration depicting common side effects of drugs of abuse. There is an illustration of a man's body to the left. There are three columns to the right: Organ, side effect and drugs. Row: 1. Organ: Brain. Side effect: Insomnia, Drowsiness, Hallucinations, Psychosis. Drugs: Amphetamine, caffeine, Alcohol, L S D, Cocaine, P C P, amphetamines. Row: 2. Organ: Eyes. Side effect: Blurred vision, Red eyes. Drugs: P C P, Marijuana. Row: 3. Organ: Stomach. Side effect: Nausea. Drugs: Narcotics. Row: 4. Organ: Kidneys. Side effect: Increased urine output. Drugs: Alcohol, caffeine. Row: 5. Organ: Intestines. Side effect: Constipation. Drugs: Narcotics.

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A table of cost per dose comparison of prescription drugs in 2019. There are two columns: Drug and Cost is dollars. Under cost are four columns: United States, Canada, India and United Kingdom, Australia. Row: 1. Drug: Celebrex 200 milligrams. Cost in United States: 13.72 dollars. Cost in

Canada: 1.91 dollars. Cost in India: 1.05 dollars. Cost in United Kingdom, Australia: 0. Row: 2. Drug: Paxil 20 milligrams. Cost in United States: 6.83 dollars. Cost in Canada: 2.98 dollars. Cost in India: 0.98 dollars. Cost in United Kingdom, Australia: 0. Row: 3. Drug: Nexium 40 milligrams. Cost in United States: 7.78 dollars. Cost in Canada: 3.37 dollars. Cost in India: 0.35 dollars. Cost in United Kingdom, Australia: 2.21 dollars. Row: 4. Drug: Viagra 100 milligrams. Cost in United States: 58.72 dollars. Cost in Canada: 10.77 dollars. Cost in India: 4.44 dollars. Cost in United Kingdom, Australia: 8.31. Row: 5. Drug: Nasonex 50 micrograms. Cost in United States: 648.00 dollars. Cost in Canada: 50.00 dollars. Cost in India: 113.92 dollars. Cost in United Kingdom, Australia: N A.

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A line graph of three waves in the rise of opioid overdose deaths. The horizontal axis represents years from 1999 to 2019. The vertical axis represents deaths per 100000 population from 0 to 17. The four factors measures are any opioids, other synthetic opioid, heroid and commonly prescribed opioids. The any opioids line begins at 3 deaths per 100000 in 1999 and begins to steadily rise until ending at 16 deaths per 100000 in 2019. The other synthetic opioid line begins a little over 0 deaths per 100000 in 1999 and follows a linear path until 2013. From here, the line rises and ends at approximately 11 deaths per 100000. The commonly prescribed opioids line begins a little over 1 deaths per

100000 in 1999. From here the line rises steadily until 2017 at approximately 5 deaths per 100000. The line then declines and ends at 3 deaths per 100000 in 2019. The heroin line begins a little under 1 death per 100000 in 1999. The line begins to follow a linear path to 2010. From here it rises to 2016 at approximately 4 deaths per 100000 and declines to end at 3 deaths per 100000 in 2019. From 1999 is wave 1. Rise in prescription opioid overdose deaths started in 1999. Wave 2 begins in 2010. Rise in heroin overdose deaths started in 2010. Wave 3 begins in 2013. Rise in synthetic opioid overdose deaths started in 2013.

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A table of classification of drugs that affect the central nervous system. There are six columns: Drug classification, common or trade name, medical uses, effects of average dose, physical dependence and tolerance develops. Row: 1. Drug classification: Opiates. Common or trade name: Codeine. Darvon. Demerol. Fentanyl. Heroin. Methadone. Morphine. Opium. Oxycontin. Percodan. Vicodin. Dextromethorphan. Medical uses: Analgesic, pain relief. Cough suppressant. Effects of average dose: Blocks or eases pain; may cause drowsiness and euphoria; some users experience nausea or itching sensations. Physical dependence: Marked. Tolerance develops: Yes. Row: 2. Drug classification: Sedatives. Common or trade name: Amytal. Nembutal. Phenobarbital. Seconal. Doriden. Quaalude. Halcion. Medical uses: Sedation, tension relief.

Effects of average dose: Relaxation, sleep; decreases alertness and muscle coordination. Physical dependence: Marked. Tolerance develops: Yes. Row: 3. Drug classification: Minor tranquilizers. Common or trade name: Dalmane. Equanil, Miltown. Librium. Valium. Xanax. Medical uses: Anxiety relief, muscle tension relief. Effects of average dose: Mild sedation; increased sense of well-being; may cause drowsiness and dizziness. Physical dependence: Marked. Tolerance develops: No. Row: 4. Drug classification: Major tranquilizers or phenothiazines. Common or trade name: Mellaril. Thorazine. Prolixin. Medical uses: Psychosis control. Effects of average dose: Heavy sedation, anxiety relief; may cause confusion, muscle rigidity, convulsions. Physical dependence: None. Tolerance develops: No. Row: 5. Drug classification: Alcohol. Common or trade name: Beer. Wine. Distilled liquor. Medical uses: None. Effects of average dose: Relaxation; loss of inhibition; mood swings; decreased alertness and coordination. Physical dependence: Marked. Tolerance develops: Yes. Row: 6. Drug classification: Inhalants. Common or trade name: Amyl nitrite. Butyl nitrite. Nitrous oxide. Medical uses: Muscle relaxant, anesthetic. Effects of average dose: Relaxation, euphoria; causes dizziness, headache, drowsiness. Physical dependence: None. Tolerance develops: ?. Row: 7. Drug classification: Stimulants. Common or trade name: Benzedrine. Biphedamine. Desoxyn. Dexedrine. Methedrine. Preludin. Ritalin. Medical uses: Weight control; relief from narcolepsy, fatigue, and hyperactivity in children. Effects of average

dose: Increased alertness and mood elevation; less fatigue and increased concentration; may cause insomnia, anxiety, headache, chills, and rise in blood pressure; organic brain damage after prolonged use. Physical dependence: Mild to none. Tolerance develops: Yes.

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Row: 8. Drug classification: Cocaine. Common or trade name: Cocaine hydrochloride. Medical uses: Local anesthetic, pain relief. Effects of average dose: Effects similar to stimulants. Physical dependence: Mild to none. Tolerance develops: No. Row: 9. Drug classification: Cannabis. Common or trade name: Marijuana. Hashish. Medical uses: Relief of glaucoma, asthma, nausea accompanying chemotherapy. Effects of average dose: Relaxation, euphoria, altered perception; may cause confusion, panic, hallucinations. Physical dependence: Mild to none. Tolerance develops: No. Row: 10. Drug classification: Hallucinogens. Common or trade name: L S D. P C P. Mescaline. Peyote. Psilocybin. Medical uses: None. Effects of average dose: Altered perceptions, visual and sensory distortion; mood swings. Physical dependence: None. Tolerance develops: Yes. Row: 11. Drug classification: Nicotine. Common or trade name: In tobacco. Medical uses: None. Effects of average dose: Altered heart rate; tremors; excitation. Physical dependence: Yes. Tolerance develops: Yes.

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A bar graph is depicted. The horizontal axis represents dose in milligrams and the vertical axis represents percentage of patients showing relief from 10 to 50. Placebo is at approximately 18 percent of patients. 20 milligrams is at approximately 24 percent. 40 milligrams is at 38 percent. 80 milligrams is at 49 percent.

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A bar graph of number of Americans older than 12 with substance abuse disorder. The horizontal axis represents drugs and the vertical axis represents millions of people. Alcohol is used by 15.7 million people. Marijuana is used by 4 million people. Pain relievers are used by 2 million people. Cocaine is used by 0.9 million people. Methamphetamine is used by 0.9 million people. Heroin is used by 0.6 million people.

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An illustration of the alcohol content of various liquors. There is an illustration of a man with the following body parts visible: Brain, eyes, pharynx, heart, esophagus, lungs, liver, spleen, stomach, pancreas, rectum, muscles, testes, blood and bone marrow and nerves. For the brain: Brain Impaired memory and other cognitive functions, most notably alcohol-related dementia. Impaired vitamin B1 thiamin absorption, causing Wernicke-Korsakoff syndrome, characterized by

impairment of memory and learning ability, apathy, and degeneration of the white brain matter. For the eyes: Tobacco-alcohol blindness; Wernicke's ophthalmoplegia, a reversible paralysis of the muscles of the eye. For the pharynx: Cancer of the pharynx is increased 10-fold for drinkers who smoke. For the heart: Alcoholic cardiomyopathy, a heart condition. Lungs: Lowered resistance is thought to lead to greater incidences of tuberculosis, pneumonia, and emphysema. For liver: An acute enlargement of the liver, which is reversible, as well as irreversible cirrhosis of the liver. For the spleen: Hypersplenism. For the stomach: Gastritis and chronic pancreatitis. For the rectum: Hemorrhoids. For the testes: Atrophy of the testes. For the muscles: Alcoholic myopathy, a condition resulting in painful muscle contractions. For blood and bone marrow: Coagulation defects and anemia. For nerves: Polyneuritis, a condition characterized by loss of sensation.

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A table of behavioural effects of alcohol in a 150-pound, 68 kilogram, male. There are five columns: Number of drinks, ounces of alcohol, BAC in grams per deciliter, Approximate time for removal and effects. Row: 1. Number of drinks: 1 beer, 1 glass of wine, or 1 mixed drink. Ounces of alcohol: half. BAC in grams per deciliter: 0.02. Approximate time for removal: 1 hour. Effects: Feeling relaxed or loosened up. Row: 2. Number of drinks: 2 and half beers, 2 and half

glasses of wine, or 2 and half mixed drinks. Ounces of alcohol: 1 and quarter. B A C in grams per deciliter: 0.05. Approximate time for removal: 2 and half hours. Effects: Feeling relaxed or loosened up. Feeling high; decrease in inhibitions; increase in confidence; judgment impaired. Row: 3. Number of drinks: 5 beers, 5 glasses of wine, or 5 mixed drinks. Ounces of alcohol: 2 and half. B A C in grams per deciliter: 0.10. Approximate time for removal: 5 hours. Effects: Memory impaired; muscular coordination reduced; slurred speech; euphoric or sad feelings. Row: 4. Number of drinks: 10 beers, 10 glasses of wine, or 10 mixed drinks. Ounces of alcohol: 5. B A C in grams per deciliter: 0.20. Approximate time for removal: 10 hours. Effects: Slowed reflexes; erratic changes in feelings. Row: 5. Number of drinks: 15 beers, 15 glasses of wine, or 15 mixed drinks. Ounces of alcohol: 7 and half. B A C in grams per deciliter: 0.30. Approximate time for removal: 15-16 hours. Effects: Stuporous, complete loss of coordination; little sensation. Row: 6. Number of drinks: 20 beers, 20 glasses of wine, or 20 mixed drinks. Ounces of alcohol: 10. B A C in grams per deciliter: 0.40. Approximate time for removal: 20 hours. Effects: May become comatose; breathing may cease. Row: 7. Number of drinks: 25–30 beers, 25–30 glasses of wine, or 25–30 mixed drinks. Ounces of alcohol: 15-20. B A C in grams per deciliter: 0.50. Approximate time for removal: 26 hours. Effects: Fatal amount for most people.

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A graph of drinks 2-hour period. 1 and half ounce liquor or 12 ounce beer. The horizontal axis represents effects of drinking on driving. The vertical axis represents weight. The three factors measured as be careful driving B A C is equal to up to 0.05 percent, Driving will be iimpaired B A C is equal to 0.05 percent to 0.08 percent and do not drive B A C is equal to 0.08 to 0.10 percent. At a weight of 100, after 2 ounces of liquor, you have to be careful driving. At a weight of 180, after 3 ounces of liquor, you have to be careful driving. At a weight of 240, after 4 ounces of liquor, you have to be careful driving. At a weight of 100, after 3 ounces of liquor, driving will be impaired. At a weight of 180, after between 4 to 5 ounces of liquor, driving will be impaired. At a weight of 220, after between 4 to 6 ounces of liquor, driving will be impaired. At a weight of 100, after between 4 to 12 ounces of liquor, do not drive. At a weight of 160, after between 5 to 12 ounces of liquor, do not drive. At a weight of 240, after between 7 to 12 ounces of liquor, do not drive.

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A set of illustrations depicting health effects of tobacco use. To the left is a can of beer. Below it are the words: about 5 percent alcohol. Next is an illustration of a glass of juice. Below it are the words: about 7 percent alcohol. Next is a glass of wine. Below it are the words: about 12 percent alcohol. To the right is a glass of whiskey and a shot glass. Below it are the words: 40 percent alcohol. To the top is the sentence: 12 fluid ounces of regular beer is equal to 8-9 fluid

ounces of malt liquor, as shown in a 12 ounce glass, is equal to 5 fluid ounces of table wine is equal to 1.5 fluid ounce shot of 80-proof distilled spirits like gin, rum, tequila, vodka, whiskey, etc.

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A line graph of percentage of uninsured adults by socioeconomic status from 2010-2020. The horizontal axis represents years and the vertical axis represents percent uninsured. The three factors measured are poor, near poor and not poor. The poor line begins in 2010 at under 50 percent uninsured. The line begins to drop, touching under 25 percent uninsured in 2015. It ends in 2020 at 14.4 percent uninsured. The near poor line begins in 2015 at under 25 percent uninsured, where the poor line was in 2015. From here it marginally drops, ending in 2020 at 11.2 percent uninsured. The not poor line begins in 2010 at less than 25 percent uninsured. It drops marginally and ends at 6.6 percent insured in 2020.

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A bar graph of racial differences in life expectancy at birth in the United States in 2021. The horizontal axis represents sexes and vertical axis represents age in years. The factors measured are all races, african american, white not hispanic and hispanic. Under both sexes, all races are at 76.6 years, african americans are at 71.6 years, white not hispanic are at

76.9 years and hispanic are at 78.2 years. Under male, all races are at 73.9 years, african americans are at 67.8 years, white not hispanic are at 74.3 years and hispanic are at 74.7 years. Under female, all races are at 79.6 years, african americans are at 75.4 years, white not hispanic are at 79.5 years and hispanic are at 81.8 years.

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An illustration of the acupuncture points on the human body. To the left are the name and number of the acupuncture point while to the right are the organs influenced by stimulating acupuncture point. For B 12 acupuncture point, the lungs are stimulated. For B 14 acupuncture point, the pericardium is stimulated. For B 15 acupuncture point, the heart is stimulated. For B 18 acupuncture point, the liver is stimulated. For B 19 acupuncture point, the gallbladder is stimulated. For B 20 acupuncture point, the spleen is stimulated. For B 21 acupuncture point, the stomach is stimulated. For B 23 acupuncture point, the kidney is stimulated. For B 25 acupuncture point, the large intestine is stimulated. For B 27 acupuncture point, the small intestine is stimulated. For B 28 acupuncture point, the bladder is stimulated.

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A bar graph depicting increase in average life expectancy after Age 50 resulting from curing major diseases or from

slowing aging processes. The horizontal axis represents years of life left at age 50. The vertical axis represents the following: 1. Average life expectancy now is approximately 33 years left at age 50. 2. Cure cancer is approximately 36 years left at age 50. 3. Cure heart disease is approximately 37 years left at age 50. 4. Cure cancer, heart disease is approximately 39 years left at age 50. 5. Cure cancer, heart disease, stroke and diabetes is approximately 48 years left at age 50. 6. Slow aging is approximately 63 years left at age 50.

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A line graph of approximate survival curves for various populations. The horizontal axis represents age in years and percent of population surviving on the vertical axis. The first line is Rome 1100 B C runs closer to the vertical axis. It starts at 100 percent, and by 20 years, it is at approximately less than 75 percent. Then line then curves downwards, touching approximately 50 percent at 40 years. At 60 years, it is at approximately 10 percent and by 80 years, it is at approximately 5 percent. The second is the United States 1900 line. It starts at 100 percent, and by 20 years, it is at approximately over than 75 percent. Then line then curves downwards, touching approximately little less than 75 percent at 40 years. At 60 years, it is at approximately 60 percent and by 80 years, it is at approximately 15 percent. The third is the United States 2000 line. It starts at 100 percent, and by 20 years, it is at approximately 95 percent.

Then line then curves downwards, touching approximately 90 percent at 40 years. At 60 years, it is at approximately 85 percent and by 80 years, it is at approximately 75 percent.

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A line graph depicting benefits of slowing onset of Alzheimer's disease. The horizontal axis represents age in years and the vertical axis represents prevalence in percentage. The two factors measured are actual situation and hypothetical situation. The actual situation line starts at approximately less than 75 years and begins to rise up towards the right in a straight line. By 80 years, the line is a little less than 10 percent prevalence. By 85 years, the line is at approximately 20 percent prevalence. By 90 years, the line is at approximately 50 percent prevalence. The hypothetical situation line starts at approximately less than 80 years and begins to rise up towards the right in a straight line. By 80 years, the line is at approximately 3 percent prevalence. By 85 years, the line is at approximately 10 percent prevalence. By 90 years, the line is at approximately 20 percent prevalence.

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An illustration of the human eye. To the left is the illustration of a man standing. To the right is an illustration of the eye and its components. To the left of the eye is the outer layers, starting with the cornea, iris and pupil. To the inner regions,

just after the pupil, is the lens. In between is the posterior cavity filled with vitreous humor. Touching the tip of the eye, at the right, is the macula. Towards the outer layers of the eye, towards the right, are the retina, choroid, sclera. The eye is connected to the body through the optic nerves, artery and vein.

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A table of the 10 leading causes of death by age group, United States in 2018. The age groups are measured horizontally and the rank is measured vertically. At rank 1, less than a year, congenital anomalies are at 4473. Between 1-4, unintentional injuries are at 1226. Between 5-9, unintentional injuries are at 734. Between 10-14, unintentional injuries are at 692. Between 15-24, unintentional injuries are at 12044. Between 25-34, unintentional injuries are at 24614. Between 35-44, unintentional injuries are at 22667. Between 45-54, malignant neoplasms are at 37301. Between 55-64, malignant neoplasms are at 113947. Between 65 plus, heart disease are at 526509. Total heart disease is at 655381. At rank 2, less than a year, short gestation are at 3679. Between 1-4, congenital anomalies are at 384. Between 5-9, malignant neoplasms are at 393. Between 10-14, suicide are at 596. Between 15-24, suicide are at 6211. Between 25-34, suicide are at 8020. Between 35-44, malignant neoplasms are at 10640. Between 45-54, heart disease are at 32220. Between 55-64, heart disease are at 81042. Between 65

plus, malignant neoplasms are at 431102. Total malignant neoplasms are at 599274. At rank 3, less than a year, maternal pregnancy complications are at 1358. Between 1-4, homicide are at 353. Between 5-9, congenital anomalies are at 201. Between 10-14, malignant neoplasms are at 450. Between 15-24, homicide are at 4607. Between 25-34, homicide are at 5234. Between 35-44, heart disease are at 10532. Between 45-54, unintentional injury are at 23056. Between 55-64, unintentional injury are at 23639. Between 65 plus, chronic lower respiratory disease are at 135560. Total unintentional injury are at 167127. At rank 4, less than a year, S I D S are at 1334. Between 1-4, malignant neoplasms are at 326. Between 5-9, homicide are at 121. Between 10-14, congenital anomalies are at 172. Between 15-24, malignant neoplasms are at 1371. Between 25-34, malignant neoplasms are at 3684. Between 35-44, suicide are at 7521. Between 45-54, suicide are at 8345. Between 55-64, chronic lower respiratory disease are at 18804. Between 65 plus, cerebrovascular are at 127244. Total chronic lower respiratory disease are at 159486. At rank 5, less than a year, unintentional injury are at 1168. Between 1-4, influenza and pneumonia are at 122. Between 5-9, influenza and pneumonia are at 71. Between 10-14, homicide are at 168. Between 15-24, heart disease are at 905. Between 25-34, heart disease are at 3561. Between 35-44, homicide are at 3304. Between 45-54, liver disease are at 8157. Between 55-64, diabetes mellitus are at 14941. Between 65 plus,

Alzheimer's disease are at 120658. Total cerebrovascular are at 147810.

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At rank 6, less than a year, placenta cord membranes are at 724. Between 1-4, heart disease are at 115. Between 5-9, chronic lower respiratory disease are at 68. Between 10-14, heart disease are at 101. Between 15-24, congenital anomalies are at 354. Between 25-34, liver disease are at 1008. Between 35-44, liver disease are at 3108. Between 45-54, diabetes mellitus are at 6414. Between 55-64, liver disease are at 13945. Between 65 plus, diabetes mellitus are at 60182. Total Alzheimer's disease are at 122019. At rank 7, less than a year, bacterial sepsis are at 579. Between 1-4, perinatal period are at 62. Between 5-9, heart disease are at 68. Between 10-14, chronic lower respiratory disease are at 64. Between 15-24, diabetes mellitus are at 246. Between 25-34, diabetes mellitus are at 837. Between 35-44, diabetes mellitus are at 2282. Between 45-54, cerebrovascular are at 5128. Between 55-64, cerebrovascular are at 12789. Between 65 plus, unintentional injury are at 48295. Total diabetes mellitus are at 84946. At rank 8, less than a year, circulatory system disease are at 428. Between 1-4, septicemia are at 54. Between 5-9, cerebrovascular are at 34. Between 10-14, cerebrovascular are at 43. Between 15-24, influenza and pneumonia are at 200. Between 25-34, cerebrovascular are at 567. Between 35-44, cerebrovascular are at 1704. Between 45-54, chronic low respiratory disease

are at 3807. Between 55-64, suicide are at 8540. Between 65 plus, influenza and pneumonia are at 48888. Total influenza and pneumonia are at 59120. At rank 9, less than a year, respiratory distress are at 390. Between 1-4, chronic lower respiratory disease are at 50. Between 5-9, septicemia are at 34. Between 10-14, influenza and pneumonia are at 51. Between 15-24, chronic lower respiratory disease are at 165. Between 25-34, H I V are at 482. Between 35-44, influenza and pneumonia are at 956. Between 45-54, influenza and pneumonia are at 2380. Between 55-64, septicemia are at 5956. Between 65 plus, nephritis are at 42232. Total nephritis are at 51386. At rank 10, less than a year, respiratory distress are at 375. Between 1-4, chronic lower respiratory disease are at 43. Between 5-9, septicemia are at 19. Between 10-14, benign neoplasms are at 30. Between 15-24, complicated pregnancy are at 151. Between 25-34, influenza and pneumonia are at 457. Between 35-44, septicemia are at 829. Between 45-54, influenza and pneumonia are at 2339. Between 55-64, influenza and pneumonia are at 5858. Between 65 plus, Parkinson's disease are at 32988. Total suicide are at 48344.

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A diagram of epidemiologic model for unintentional injuries. Diagram A: There are three circles overlapping in the center. The right circle is environment. The left circle is person and the bottom circle is agent. The area where they are all overlapping is accident. Diagram B: There are three circles

overlapping in the center. The right circle is environment. The left circle is person and the bottom circle is vehicle. The left circle has the text: Nighttime, rain, narrow road. The right circle has the text: Drinking, tired. The bottom circle has the text: Driving past speed limit, lack of turn signal. The area where they are all overlapping is injury.

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A bar graph of approximate number of unintentional injury deaths at home and in the community, United States, 2018. The horizontal axis represents type of injury. The vertical axis represents number of unintentional deaths. Fires or flames are at 3100 unintentional deaths while drowning is at 3500 unintentional deaths. Suffocation is at 3080 unintentional deaths while falls is at 35707 unintentional deaths. Poisoning is at 72473 deaths.

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A bar graph of U S deaths from drug overdose between 2010 and 2019. The horizontal axis represents years and the horizontal axis represents number of deaths. In 2010, there were 38329 deaths. In 2014, there were 47055 deaths. In 2015, there were 52404 deaths. In 2019, there were 70030 deaths.

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A bar graph depicting rates of firearm violence among several developed countries. On the horizontal axis are the countries and on the vertical axis is the guns and gun death numbers. In the United States, guns per 100 people is 120.5 and gun deaths per 100000 is 12.1. In Switzerland, guns per 100 people is 27.6 and gun deaths per 100000 is 2.84. In Finland, guns per 100 people is 32.4 and gun deaths per 100000 is 2.65. In Canada, guns per 100 people is 34.7 and gun deaths per 100000 is 1.94. In Austria, guns per 100 people is 30.0 and gun deaths per 100000 is 2.91. In Norway, guns per 100 people is 28.8 and gun deaths per 100000 is 1.52. In Germany, guns per 100 people is 19.6 and gun deaths per 100000 is 1.01. In New Zealand, guns per 100 people is 26.3 and gun deaths per 100000 is 1.24. In Italy, guns per 100 people is 19.6 and gun deaths per 100000 is 0.97. In Ireland, guns per 100 people is 7.2 and gun deaths per 100000 is 0.58. In United Kingdom, guns per 100 people is 5.0 and gun deaths per 100000 is 0.17. In Netherlands, guns per 100 people is 2.6 and gun deaths per 100000 is 0.44. In Japan, guns per 100 people is 0.25 and gun deaths per 100000 is 0.1.

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A table of feelings reported by sexual assault victims. There are ten columns. Column 1: Fear: 1. Fear of death. 2. Fear of rapist. Column 2: Embarrasment: 1. Embarrassed to discuss details. 2. Embarrassed about their bodies. Column 3: Shame: 1. Destruction of self esteem, self-worth, self-

respect. 2. Ashamed of having the medical exam. 3. Ashamed of having to perform a sexual act to stay alive. Column 4: Guilt: 1. Feelings of shame and of having provoked the rape. 2. Feeling of blame for the assault. Column 5: Anxiety: 1. Shaking. 2. Nightmares. 3. Difficulty sleeping or sleeping all the time. 4. Constantly reminds self what should or shouldn't have been done. Column 6: Stupidity: Feels stupid for engaging in risk-taking behavior. 2. Feels stupid for being too trusting. Column 7: Vulnerability: 1. General fear of people. 2. Paranoid feelings. 3. Intensely heightened awareness of environment. Column 8: Concern: 1. Will the rapist get psychiatric help? 2. What will happen to offender if rape is reported? Column 9: Anger: 1. Toward assailant. 2. Toward self. 3. Toward men and women, in general, especially if they resemble assailant.

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A diagram of the greenhouse effect. A quarter of the Earth is depicted to the bottom right. Above the surface of Earth is a thick layer going around it which is the ozone layer. Within this layer are carbon dioxide gases. To the top right is the sun. From the sun, there are curvy lines moving in the direction of the ozone layer. These are U V and visible light. Within the layer, they turn into infrared light. Some of the infrared light penetrate into the surface of the Earth while some around bounced off it.

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A line graph of global temperature changes from 1880 to 2020. The horizontal axis represents years while the vertical axis represents temperature anomaly. The factors measured are annual mean and lowness smoothing. The lowness smoothing line begins a little under 0 degrees celsius. It drops and rises in 1900. From here it drops again to its lowest around 1910 to approximately minus 0.4 degrees. From here it begins to steadily rise, touching approximately 0.2 degrees in 1940. It momentarily falls again but begins to steadily rise, touching 0.5 degrees around 2010. The line ends at 1 degree in 2020. The annual mean line is following the same path as the lowness smoothing line.

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A chart of advice on eating fish. There are three columns, one to the left and two to the right. The first is titled: Best choices. Eat 2 to 3 servings a week. They are: Anchovy, Atlantic croaker, Black sea bass, Butterfish, Catfish, Clam, Cod, Crab, Crawfish, Flounder, Haddock, Hake, Atlantic mackerel, Herring, Mullet, Oyster, Pacific chub mackerel, Perch, freshwater and ocean, Pickerel, Plaice, Pollock, Salmon, Sardine, Lobster, American and spiny, Scallop, Shad, Shrimp, Skate, Smelt, Sole, Squid, Tilapia, Trout, freshwater, Tuna, canned light, includes skipjack, Whitefish and Whiting. The second column is titled: Good choices. Eat 1 serving a week. They are: Bluefish, Buffalofish, Carp, Chilean sea bass or Patagonian toothfish, Grouper, Halibut, Mahi mahi or dolphinfish, Monkfish, Rockfish, Sablefish,

Sheepshead, Snapper, Spanish mackeral, Striped bass ocean, Tilefish Atlantic Ocean, Tuna, albacore or white tune canned and frozen or fresh, Tuna, yellowfin, Weakfish or seatrout, White croaker or pacific croaker. The third column is titled: Choices to avoid. Highest mercury levels. They are: King mackerel, Marlin, Orange roughy, Shark, Swordfish, Tilefish Gulf of Mexico, Tuna, bigeye.

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A section of a page that is titled: Profiting from making people sick. There are paragraphs under it. There is a graph to the right which depicts sales figures for 33 leading transnational corporations in 2017 by sector. The horizontal axis represents food product category and the vertical axis represents world sales in US billion dollars in 2017.

Processed food is at 345 billion dollars. Tobacco and alcohol is at 150 billion dollars. Soft drinks is at 100 billion dollars. Fast food is at 60 billion dollars.

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